

CORRECTED VERSION

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
16 January 2003 (16.01.2003)

PCT

(10) International Publication Number
WO 2003/005281 A1

(51) International Patent Classification⁷: G06G 7/48,
A63B 53/12

Loren; 5545 Fermi Court, Carlsbad, CA 92008-1517 (US). WRIGHT, Ian, C.; 5545 Fermi Court, Carlsbad, CA 92008-1517 (US). WHITE, Jay; 5545 Fermi Court, Carlsbad, CA 92008-1517 (US).

(21) International Application Number:
PCT/US2002/020938

(74) Agent: CARR, John; Sheppard Mullin Richter & Hampton LLP, 333 South Hope Street, 48th Floor, Los Angeles, CA 90071 (US).

(22) International Filing Date: 1 July 2002 (01.07.2002)

(25) Filing Language: English

(81) Designated States (national): GB, JP.

(26) Publication Language: English

Published:
— with international search report

(30) Priority Data:
60/302,777 2 July 2001 (02.07.2001) US

(48) Date of publication of this corrected version:
8 April 2004

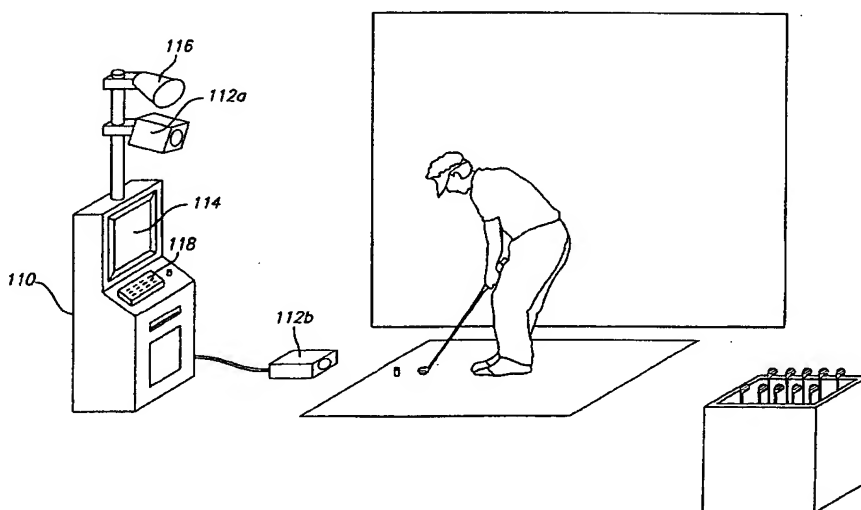
(71) Applicant: TAYLOR MADE GOLF COMPANY, INC.
[US/US]; 5545 Fermi Court, Carlsbad, CA 92008-1517 (US).

(15) Information about Correction:
see PCT Gazette No. 15/2004 of 8 April 2004, Section II

(72) Inventors: ANDERSON, David; 5545 Fermi Court, Carlsbad, CA 92008-1517 (US). VINCENT, Benoit; 5545 Fermi Court, Carlsbad, CA 92008-1517 (US). STOWE,

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: AUTOMATED METHOD AND SYSTEM FOR GOLF CLUB SELECTION BASED ON SWING TYPE



(57) Abstract: A method (3) of selecting a performance golf club based on a golfer's swing type is accomplished in an automated fashion and a system (1-2) that is readily and easily utilized in a retail setting, for example. The golfer performs several swings of a golf club (7-9) before a digital camera (112, 212) that transmits the golfer's swing information to a computational device (not shown) for processing. Several parameters relating to the golfer's swing characteristics are identified and a performance golf club is selected and displayed for the golfer within less than one hour (3), and preferably within about five to ten minutes. Markers (610, 710a-b, 810a-b) may be positioned on the golf club and/or the golfer for easier tracking and data collection by the system (1-2).

**AUTOMATED METHOD AND SYSTEM FOR GOLF CLUB
SELECTION BASED ON SWING TYPE**

Field of the Invention

5 The present invention relates generally to a system and method for
matching a golfer to a golf club type based upon his or her swing type
characteristics, and, specifically, to a compact, user-friendly system whereby a
golfer may quickly and automatically determine an appropriate golf club type based
10 upon swing type characteristics measured and processed within a retail location.

Background of the Invention

15 Since the origins of golf several hundred years ago, those who
participate in the game have sought to improve their performance through their
choice of equipment. In particular, an annual ritual for many golfers is the
purchase of one or more newer, improved golf clubs that "feel" better when swung
by the golfer or that at least promise some advancement in technology, whether
size, weighting, materials or something else.

20 One approach to optimizing a golfer's game is to identify a "type" of
swing of the golfer so that an appropriate golf club may be selected. Some of the
prior art systems and methods used to provide a swing type of identification for the
golfer are discussed herein.

25 U.S. Patent 4,137,566 to Haas et al. discloses a plurality of
electro-optical sensors used to capture swing data from a marked golf club and/or
golfer. The analog information is digitized and data on the positions of the golf

club and significant human body parts are stored. A coordinate transformer allows viewing of a simulated golfer at any aspect, as well as optional graphic and/or tabular displays of the data. While this system is useful for capturing the swing characteristics of the golfer, the data must be separately analyzed by an expert and the process is cumbersome and not automated.

U.S. Patent 5,111,410 to Nakayama et al. teaches the use of a video-based system which automatically measures and compares a golfer's swing to stored, reference swing data. Based upon the determined differences in the data, the closest reference data is determined and a diagnosis of the golfer's swing is made. There is also an automatic trigger mechanism which allows simple operation for use at a golf driving range, for example. This system is designed primarily as a teaching aid to improve the golfer's swing. The golfer's swing is analyzed based solely upon motion analysis.

U.S. Patent 5,342,054 to Chang et al. discloses a video-based system that includes color video cameras and an infrared camera in conjunction with image processing software and data storage in a circular buffer. In addition, compression and decompression of data is disclosed. Optionally, a sensor array is utilized and various data displays may be chosen.

U.S. Patent 5,772,522 to Nesbit et al. discloses the creation of a three-dimensional biomechanical model of a golfer which is superimposed with data of a specific golfer's swing. A plurality of markers may be used on the golfer in addition to triad markers on the club and a plurality of cameras to obtain the golfer's swing data for superposition.

U.S. Patent 6,083,123 to Wood discloses the generation of a custom set of clubs based on a club chemistry that is determined according to data obtained

on the golfer's swing. A reference club is first defined and then inferences are made with respect to club parameters to create an entire custom club set.

5 Published PCT Application WO 00/15311 A1 discloses an apparatus and method for analyzing a golfer's individual swing attributes and determining a suitable golf club configuration for that golfer. The apparatus includes video cameras for obtaining video images of a golfer's swing. The images are analyzed to determine the golf club dimensions that will provide improved results in combination with the golfer's individual swing characteristics. The golf club
10 dimensions for modification based on the analysis include loft and lie angles, for example.

 Published PCT Application WO 00/41776 A1 discloses a video capture unit for recording and displaying recorded activities such as golf. The
15 recorded activities are saved and may be separately viewed remote from the video capture unit; the activities may also be uploaded to the Internet for later viewing and analysis. Through any PC or other Internet connection, the user may input personal identification information associated with the saved images, and analysis tools may be downloaded for use with the saved images.

20 Published PCT Application WO 00/71212 A1 discloses a method of matching a golfer to a golf club and golf ball by comparing measured values to recorded sets of data. The value to be measured is clubhead speed, and the sets of data for comparison include golf club loft angle, shaft flex, golf ball weight and ball
25 spin.

 U.S. Patent 6,086,487 to Morgan et al. discloses the use of web sites to query a user for information on his or her style of play that is compared to stored information to return a predetermined selection for a golf ball.

Published PCT Application WO 01/28644 A1 discloses a method and system for teaching a skill such as golf to a student. The system includes cameras to create a series of images representative of the student performing the skill. The images are stored in digital format by a computer system so that they are accessible from a telecommunication network, such as the Internet. An expert in the skill then accesses the images, examines them, and creates a series of annotated digital images of the student performing the skill. The annotated digital images are stored for later access by the student via the telecommunication network.

The techniques described above suffer from various disadvantages, including but not limited to a reliance on expert (human) assistance, expensive or complex hardware, inconvenience due to limited availability of the system, and data formats that may be difficult to interpret for selecting a golf club. Thus, there exists a need for a system and method for the quick and easy measuring a golfer's swing characteristics and identifying the golfer's swing type in a convenient location, such as a local driving range or golf course pro shop, for the purpose of determining an ideal club type for purchasing.

Brief Description of the Drawings

FIG. 1 illustrates a preferred embodiment of the system of the present invention as located within a retail setting such as a pro shop at a golf course.

5

FIG. 2 illustrates a second preferred embodiment of the system of the present invention as located outdoors such as at a golf course or driving range.

FIG. 3 is a flowchart showing a possible sequence of steps employed in a method of the present invention.

10

FIG. 4 is a flowchart showing a possible sequence of steps employed in an alternative method of the present invention.

FIG. 5 shows an alternative device for collection of data in the system of the present invention.

15

FIG. 6 shows a golfer having markers in accordance with an embodiment of the present invention.

20

FIG. 7 shows a golf club used in carrying out the club selection process of the present invention.

FIG. 8 shows an alternative golf club used in carrying out the club selection process of the present invention.

25

FIG. 9 shows yet another alternative golf club used in carrying out the club selection process of the present invention.

Detailed Description of the Preferred Embodiments

A first preferred embodiment of a system and method of the present invention is illustrated in FIG. 1. As shown, the system includes a kiosk 110 having at least one digital camera coupled thereto 112 and further including a display monitor 114. The kiosk is possibly set up inside a golf shop, the golf shop located either on or off a golf course. The system will also preferably include a light source 116 and a key pad or keyboard 118 for accepting input into the system. The kiosk includes a fully functional computer with digital signal processor. The camera is used to capture "swing" characteristics of a golfer as the golfer swings a club. These "swing" characteristics are processed by the digital signal processor within the kiosk and a preferred club for the golfer is selected and displayed on the monitor. In a preferred embodiment, the camera is capable of capturing data at a rate of at least 60 Hz.

FIG. 2 shows a second preferred embodiment of a system of the present invention wherein at least one digital camera 212 is coupled to a laptop computer 220 which includes a display. The camera and laptop are both stationed outdoors. The laptop is then networked and/or wirelessly coupled to a remotely located kiosk 110. The camera 212 and laptop 220 are used to capture "swing" characteristics of a golfer as the golfer swings a club. These "swing" characteristics are then transmitted to the remotely located kiosk, where they are then processed by the digital signal processor. In a preferred embodiment, the camera is capable of capturing data at a rate of at least 60 Hz. A preferred club for the golfer is then selected and displayed on the laptop display.

In either of the physical settings of FIGS. 1 or 2, a method of the present invention for matching a golfer with a preferred club based upon collected

swing characteristics is presented as a flowchart of FIG. 3. Preferably, the method includes the steps of:

providing a swing data collection system, said swing data collection system comprising a golf club and at least one digital camera, said golf club comprising a shaft with a grip end and a tip end having a club head attached thereto, said shaft having at least two markers thereon;

having the golfer swing said golf club at least one time;

using the digital camera to collect data about the golfer's swing, said data representing a plurality of positions of said markers occurring during said at least one swing;

providing an automated data analyzer to analyze said data, said data analyzer

(A) processing said data to determine specific values for a set of swing characteristics for the golfer, said data analyzer saving said specific values for the golfer in a memory; and

(B) selecting a performance golf club from a plurality of golf clubs based on said specific values for the golfer

The system then displays the data collected along with the selected performance club which best matches the specific values for the set of swing characteristics. The data may be displayed in either graphical or numerical form. The system may also be configured to play back the images captured by the digital camera.

Preferably, at least one marker is positioned adjacent the grip end of said golf club and at least one additional marker is positioned adjacent the club head at the tip end of said golf club. The markers may include reflective tape, light sources, or bands of one or more colors. In a preferred embodiment, a single video camera captures two dimensional data and this two dimensional data is transformed

into data representing three dimensional "swing" characteristics for the golfer, said three-dimensional data correlated to said set of swing characteristics. The mathematical analysis of the pixel data from a digital camera to accomplish the 2-D to 3-D transformation, or vice-versa, is performed using any method known to those skilled in the art.

In an alternative method of the present invention, a "markerless" tracking of natural features of the golf club, golfer and/or golf ball may be employed. That is, artificial features such as reflective tape are not used, and instead a pattern recognition technique may be used for the markings of a golf ball, for example. The glove, club head, grip, etc. may be discerned without markers by discriminating between the natural features and the other, background images.

In a preferred embodiment, the system includes means for triggering initiation of the capture of swing characteristics and further means for notifying the golfer of the state of such data collection. In a preferred embodiment, the system includes a key pad which includes a start key. The start key initiates a timer red-yellow-and-green lights or LED's included with the system indicate the status of the system. Preferably, a yellow light indicates that the system is preparing to capture or collect swing characteristics. When the system is in this mode, the golfer will preferably begin to prepare to swing the club and have his swing characteristics measured. When the light turns green, video capture is initiated and the golfer will take his swing and have the data which represent his swing characteristics collected by the system. When the LED indicators are red the system is not operating or is processing data and cannot be used to collect any more video.

In an alternative embodiment, the data collection system used to collect the golfer "swing" characteristics includes two digital cameras arranged to

capture three dimensional data. In this embodiment, the data analysis correlates actual three-dimensional data captured by said at least two cameras into a set of swing characteristics and determines a preferred club type based upon these known swing characteristics.

5

In a preferred embodiment, the data collection, analysis and display occur within a specific time frame of less than about one hour. Alternatively, the data collection, analysis and display can all occur within a specific time frame of less than about 10 minutes. An advantage of the present invention is the ability to provide data collection, analysis and display of club selection results quickly – nearly “real-time” – to a golfer/consumer. Thus, with faster computation speeds according to the equipment used, the actual time frame is easily within a quick trip to the pro shop, for example.

10

15

In a preferred embodiment, the system and method of the present invention includes a memory and the ability to save said data of the golfer's swing in said memory, said method further comprising an additional step of transmitting the content of said memory via the internet to a web site for later remote access. Preferably, the data maybe compressed and encoded prior to saving it in said memory.

20

The data or “swing” characteristics collected and processed in the present invention may be utilized in an additional aspect of the present invention, as illustrated in the flowchart of FIG. 4. As shown in FIG. 4, the data may be stored and retrieved at any later time when the golfer is ready to purchase a new club from the retailer. Alternatively, the data may be transmitted to a manufacturer such that a customize golf club may be designed to match the golfer's measured swing characteristics.

25

In a preferred embodiment, a minimum of two types of data should be collected in determining a golfer's swing characteristics, such as club head speed and shaft flex, for example. In alternative embodiments, additional sensors may be used such that additional information may also be collected such as ball flight data including launch angle, or club head orientation at time of impact with the ball surface. Sensors which may be used with the golf club would include, for example, rate gyros, accelerometers, orientation sensors, strain gauges and magnetic components. The methods of applying these sensors to a club and their preferred locations are known to those skilled in the art. Miniaturization of components in particular provide the opportunity to place and use the sensors with minimal effect on the golfer's swing.

In an alternative embodiment, sensors external to the golf club may be used to measure the club movement and angle. FIG. 5 shows an embodiment wherein a mat having sensors in a fixed configuration is used to obtain club head speed and position information as the club is swung over the mat. The sensors comprise arrays of light emitters and receivers, where the light is reflected from the club head as it passes over the mat. The club head information which may be collected in the this embodiment would include such statistical information as face angle of the club and speed of the club just prior to impact with the golf ball.

In a further preferred embodiment, actual movement of the golfer himself may be measured to determine his or her swing type. This additional embodiment of the present invention is shown in FIG. 6. As shown, a golfer has specific parts of his or her upper torso marked to provide additional information for analyzing the swing characteristics, according to the desired set of swing characteristics to be used in the analysis. In this illustration, one or both shoulders and/or one or both hips may have reflective tape attached. Alternatively, clips or the like may be used to attach additional or other types of marking devices for

swing data collection. In this embodiment, a second digital camera is focused on the golfer and is used to capture information about the movement of the golfer. This information is also processed in order to more accurately determine the golfer's swing type and match him or her with a preferred club.

5

FIGS. 7-9 illustrate various embodiments for an instrumented golf club for swing data collection. Passive means, such as reflective tape, may be used and positioned at different points on the golf club 710a-b, as shown in FIG. 7. Alternatively, a more active means requiring a power source may be used. FIG. 8 shows a club having strain gauges 810a-b provided on the surface of the golf shaft and other sensors 811a-d provided on a sensing member 812 that is received within the grip end of the golf club. A battery may be included with the member as a power source, and the data may be stored in a memory element of the member or may be transmitted to a remote location via radio frequency transmission or the like to deliver the data for storage and analysis. Alternatively, the end of the golf club grip may be adapted to receive an interface 910 which links directly to a data storage and/or computing device, as shown in FIG. 9. This cable link may be removable or remain attached as the golfer swings the club.

10

15

20

One type of camera that may be used for data collection is available from Cognex in Needham, Massachusetts or Vision Components in Ettlingen, Germany, for example. This digital camera not only captures data but has an internal CPU unit co-located in its housing to perform all or part of the data analysis. The camera may then be directly linked to a display unit to present the golfer's swing information and/or club selection results. Alternatively or additionally, the camera may be linked to a separate computing device for data storage and/or transfer, for example, over the internet.

25

5 The transmission of the data collected from the sensors may be performed using a fiber optic, cable or USB link, infrared methods or radio frequency techniques. The computing devices available for processing include, for example, personal digital assistants (PDA's), laptop computers, desktop computers and point-of-purchase (POP) kiosk units. The arrangement of the data transmission connection and computing device is variable and may be designed in consideration of local space and/or power constraints as well as cost.

EXAMPLES OF SYSTEMS FOR SWING ANALYSIS/TYPE IDENTIFICATION:

10 The analysis of the golfer's swing characteristics may be performed utilizing swing information gathered as disclosed in U.S. Patents 3,792,863, 3,945,646 and 4,615,526, for example. These methods include various golf club configurations to capture information such as swing speed, club head acceleration and face angle at approach as well as shaft flex and torque. In addition, data relating to an individual's characteristic golf swing and ball launch conditions may be obtained in the manner disclosed in U.S. Patent 4,375,887, *e.g.*, using a video system to capture swing and ball launch data from the golfer. These prior swing data collection methods all are specified for use as training aids, to provide feedback to improve the golfer's swing. In the present invention, on the other hand, such methods may be employed in conjunction with at least one digital camera, as part of a club collection process.

25 Although data collection of a golfer's swing information may be done with direct video display of the golfer's image, alternatively a virtual representation of the golfer may be substituted. This image would be the result of having included the golfer's physical characteristics into a program already having fixed physical features accounted for in the data analysis. Thus, hair color, facial features, clothing and other such details could remain constant from golfer to golfer, but the

actual motion of the golfer's swing would be customized.

Exemplary methods to determine an appropriate golf club shaft type for the golfer are disclosed in U.S. Patents 5,821,417 and 6,213,888. In the former patent, shaft selection is based upon values obtained for shaft strain as well as combinations of data including shaft strain and swing speed, club acceleration and speed at impact, club speed at the top of the swing and at impact, and swing time and speed at impact. In the latter patent, three strain gauges are located on the golf club to determine appropriate shaft torque and/or kick point for the golfer leading to a choice from four types of golf club shafts.

Alternatively, determination of an optimum golf club type according to a golfer's swing characteristics may be accomplished according to a method disclosed in a co-pending and commonly assigned patent application entitled "Method of Matching Swing Type to Golf Club Style," filed on April 3, 2002, Serial No. 10/116,688. That application is incorporated by reference herein. Generally, a set of performance parameters and associated value ranges are determined such that the golfer's specific values may be correlated to an optimum club type for him or her. Additional parameters are used to further refine the club, such as loft and lie. The present invention allows the golfer to have his or her swing data processed in an automated manner such that he or she may quickly determine an appropriate golf club specifically matched to his or her swing type and immediately available for purchase.

Although the invention has been disclosed in detail with reference only to the preferred embodiments, those skilled in the art will appreciate that additional automated golf club fitting systems and methods of accomplishing same can be made without departing from the scope of the invention. Accordingly, the invention is only intended to be limited by the claims included herewith.

THE CLAIMS

What is claimed is:

5 1. A method of selecting a performance golf club from a plurality of golf clubs based on a golfer's swing characteristics, comprising:

 providing a swing data collection system, said swing data collection system comprising a golf club and at least one digital camera 112, said golf club comprising a shaft with a grip end and a tip end having a club head attached thereto, said shaft having at least two markers 710a-b thereon;

 having the golfer swing said golf club at least one time;

 collecting data about the golfer's swing using said camera, said data representing a plurality of positions of said markers occurring during said at least one swing;

15 providing an automated data analyzer 110 to analyze said data, said data analyzer

 (A) processing said data to determine specific values for a set of swing characteristics for the golfer, said data analyzer saving said specific values for the golfer in a memory; and

20 (B) selecting a performance golf club from a plurality of golf clubs based on said specific values for the golfer; and displaying said selected performance golf club.

25 2. The method as set forth in claim 1, further comprising locating at least one marker 710a adjacent the grip end of said golf club and at least one marker 710b adjacent the club head at the tip end of said golf club.

 3. The method as set forth in set claim 2, further comprising providing an illumination source 116 located near said camera, wherein said

markers comprise reflective tape.

4. The method as set forth in claim 2, wherein said markers comprise light sources.

5. The method as set forth in claim 2, wherein said markers comprise bands of one or more colors.

6. The method as set forth in claim 1, wherein said camera 112 is capable of capturing data at a rate of at least 60 Hz.

7. The method as set forth in claim 1, wherein the data analysis performed by said data analyzer comprises transforming two-dimensional data to data representing three dimensions, said three-dimensional data correlated into said set of swing characteristics.

8. The method as set in claim 1, wherein the data analysis performed by said data analyzer comprises correlating two-dimensional data into said set of swing characteristics.

9. The method as set forth in claim 1, wherein said swing data collection system comprises at least two digital cameras 112a-b, the data analysis performed by said data analyzer 110 comprising correlating three-dimensional data captured by said at least two cameras to said set of swing characteristics.

10. The method as set forth in claim 1, wherein the data collection, analysis and display occur within a specific time frame of less than about one hour.

11. The method as set forth in claim 1, wherein the data collection, analysis and display occur within a specific time frame of less than about 10 minutes.

5 12. The method as set forth in claim 1, wherein said data analyzer comprises a laptop computer 220 and said method further comprises transmitting said data via a cable link from said camera 212 to the laptop computer, said displaying of said selected performance golf club is on a monitor for the laptop computer.

10 13. The method as set forth in claim 12, further comprising:
transmitting said data via a cable link or wireless connection to a kiosk, said kiosk comprising a computational device and viewing screen; and
15 displaying of the selected performance golf club on said screen.

14. The method as set forth in claim 13, wherein said data analyzer comprises a digital signal processor located within said kiosk.

20 15. The method as set forth in claim 13 wherein the data analysis further comprises:
saving said data of the golfer's swing in a memory located within said kiosk, and
25 transmitting the content of said memory via the internet to a web site for later remote access.

16. The method as set forth in claim 15, wherein the data analysis further comprises encoding said data prior to saving it in said memory.

17. A method of selecting a performance golf club from a plurality of golf clubs based on swing characteristics for a golfer, comprising:

providing a swing data collection system, said swing data collection system comprising at least one golf club and at least one digital camera 112, said
5 golf club comprising a shaft with a grip end and a tip end having a club head attached thereto, and said shaft having at least two markers 710a-b thereon;

having the golfer swing said golf club at least one time;

collecting data about the golfer's swing using said camera,

comprising:

10 transmitting said data to an automated data analyzer;

correlating said data to specific values for a predetermined set of swing characteristics, said set of swing characteristics categorized into a plurality of swing types, said plurality of swing types associated with the plurality of golf clubs from which a performance golf club is chosen; and

15 displaying said performance golf club chosen according to said specific values.

18. The method as set forth in claim 17, further comprising displaying at least one of said specific values of said swing characteristics for the golfer.

20 19. The method as set forth above in claim 17, further comprising displaying each of said plurality of golf clubs and each of said plurality of swing types associated therewith.

25 20. The method of claim 17, further comprising displaying a set of values for each of said predetermined set of swing characteristics for each of said plurality of swing types.

21. A kiosk 110 and video fitting system for selecting a performance golf club for a golfer from a plurality of golf clubs based on the golfer's swing characteristics, said fitting system located in a retail location, said fitting system comprising:

5 at least one digital camera 112;
 at least one golf club, a golfer swinging said golf club in front of said
 camera to provide data for analysis and club selection;
 an digital signal processor, said digital signal processor processing
 said data and determining specific values for a predetermined
10 set of swing characteristics for the golfer, said kiosk then
 saving at least said data and said specific values in a memory,
 said kiosk providing as an output a selected performance golf
 club; and
said kiosk comprising a housing containing at least said digital signal processor and
15 a keypad 118 for entry of commands to control at least said camera 112 and said
 data analyzer, said kiosk further included a display 114 adapted to display said
 output of the golf club selection.

22. The fitting system as set forth in claim 21, wherein said fitting system is operated by the golfer.

20 23. The fitting system as set forth in claim 21, wherein said kiosk
 further displays said saved data of the golfer's swing.

24. The fitting system as set forth in claim 23, wherein said kiosk provides a printout of at least one of said specific values and said output of the golf club selection.

25. The fitting system as set forth in claim 21, wherein said kiosk is adapted to communicate the content of said memory over the internet for later remote access.

26. The fitting system as set forth in claim 21, wherein said golf club further comprises at least one sensor 810 selected from the group including a strain gauge, an angular rate sensor, an orientation sensor and an acceleration sensor, said at least one sensor providing additional data for analysis and selection of the performance golf club for the golfer.

27. The fitting system a set forth in claim 21, wherein said golf club has a first marker 710a located toward a grip end and a second marker 710b located toward a tip end having a club head.

28. The fitting system as set forth in claim 27, wherein said markers comprise reflective tape and said fitting system further comprises an illumination source 116 located near said camera.

29. The fitting system as set forth in claim 21, wherein said camera captures images representing a launch trajectory of a golf ball upon impact with said golf club by the golfer.

30. A method of selecting a performance golf club from a plurality of golf clubs based on a golfer's swing characteristics, comprising:

providing a swing data collection system, said swing data collection system comprising at least one golf club and at least one digital camera 112, each of said at least one golf club comprising a shaft with a grip end and a tip end having a club head attached thereto;

having the golfer swing each of said at least one golf club at least one

time;

collecting data about the golfer's swing using said camera, said data including images representing a plurality of positions of said at least one golf club occurring during said at least one swing;

5 providing a digital signal processor, said digital signal processorata analyzer

(a) processing said data to determine specific values for a predetermined set of swing characteristics for the golfer, said swing data collection system then saving said specific values for the golfer in a memory;

10 (b) categorizing the golfer as a specific swing type from a plurality of swing types; and

(c) selecting a performance golf club from a plurality of golf clubs based on said specific swing type of the golfer; and

15 displaying said selected performance golf club.

31. The method as set forth in claim 30, further comprising the additional step of attaching a first marker 610 to at least one location on the golfer prior to having the golfer swing said at least one golf club at least one time.

20 32. The method as set forth in claim 31, wherein said marker is attached to a location on the upper torso of said golfer.

33. The method as set forth in claim 31, further comprising the additional step of attaching a second marker 710a to at least one location on each of said at least one golf club prior to having the golfer swing each of said at least one golf clubs.

34. The method as set forth in claim 31, wherein said first marker comprises reflective tape and said swing data collection system further comprises an illumination source 116 located near said camera 112.

5 35. The method as set forth in claim 33, wherein said second marker comprises reflective tape and said swing data collection system further comprises an illumination source 116 located near said camera 112.

36. A method of selecting a performance golf club from a plurality of golf clubs based on a golfer's swing characteristics, comprising:

10 providing a swing data collection system, said swing data collection system comprising at least one golf club and at least one digital camera, each of said at least one golf club comprising a shaft with a grip end and a tip end having a club head attached thereto;

having the golfer swing each of said at least one golf club at least one time;

15 collecting data about the golfer's swing using said camera, said data including images representing a plurality of positions of said at least one golf club occurring during said at least one swing;

providing an automated data analyzer, said data analyzer

20 (a) processing said data to determine specific values for a predetermined set of swing characteristics for the golfer, said data analyzer saving said specific values for the golfer in a memory;

(b) categorizing the golfer as a specific swing type from a plurality of swing types; and

25 (c) selecting a performance golf club from a plurality of golf clubs based on said specific swing type of the golfer; and displaying a first sequence of images showing the golfer during said

at least one swing;

displaying a second sequence of images showing said specific swing type of the golfer; and

displaying said selected performance golf club.

5 37. The method as set forth in claim 36, further comprising displaying a plurality of image sequences corresponding to each of the plurality of swing types.

38. The method as set forth in claim 37, wherein said displaying of said first and second sequences is an overlay of the images.

10 39. The method as set forth in claim 37, wherein said displaying of said first sequence comprises overlaying said first sequence with each of said plurality of image sequences, such that the swing of the golfer is compared with each of the swing types.

15 40. A video fitting system for selecting a performance golf club for a golfer from a plurality of golf clubs based on the golfer's swing characteristics, said fitting system located in a retail location, said fitting system comprising:

at least one digital camera 112;

at least one golf club, a golfer swinging said golf club in front of said camera to provide data for analysis and club selection;

20 an automated data analyzer for processing said data and determining specific values for a predetermined set of swing characteristics for the golfer, said data analyzer saving at least said data and said specific values in a memory, said data analyzer providing as an output a selected performance golf club; and

25 a kiosk for housing said data analyzer, said kiosk including a keypad 118 for entry of commands to control at least said camera and said data analyzer,

said kiosk further including a display 114 adapted to display said output of the golf club selection.

41. The fitting system as set forth in claim 40, wherein said data analyzer further provides as a second output at least one swing characteristic from said set of swing characteristics.

42. The fitting system as set forth in claim 40, wherein said golf club comprises at least one sensor 810 for measuring strain, acceleration, orientation or rate information for said golf club, said at least one sensor providing additional data for analysis and selection of the performance golf club for the golfer.

43. A method of selecting a performance golf club from a plurality of golf clubs based on a golfer's swing characteristics, comprising:

providing a swing data collection system, said swing data collection system comprising at least one golf club and at least one digital camera, each of said at least one golf club comprising a shaft with a grip end and a tip end having a club head attached thereto;

having the golfer swing each of said at least one golf club at least one time;

collecting data about the golfer's swing using said camera, said data representing a plurality of positions of said at least one golf club occurring during said at least one swing;

providing an automated data analyzer, said data analyzer

(a) processing said data to determine specific values for a predetermined set of swing characteristics for the golfer, said data analyzer saving said specific values for the golfer in a memory;

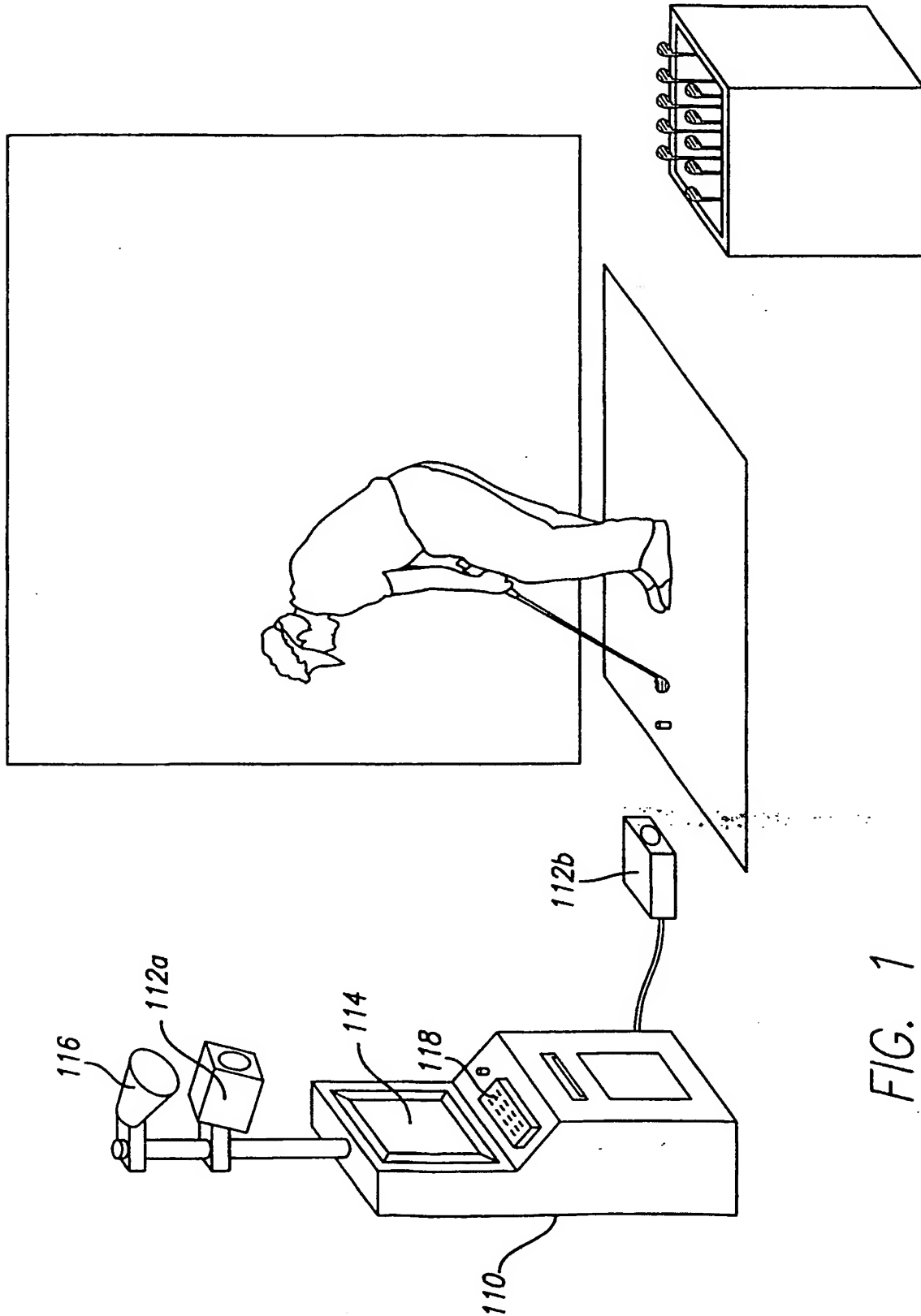
(b) categorizing the golfer as a specific swing type from a plurality of swing types; and

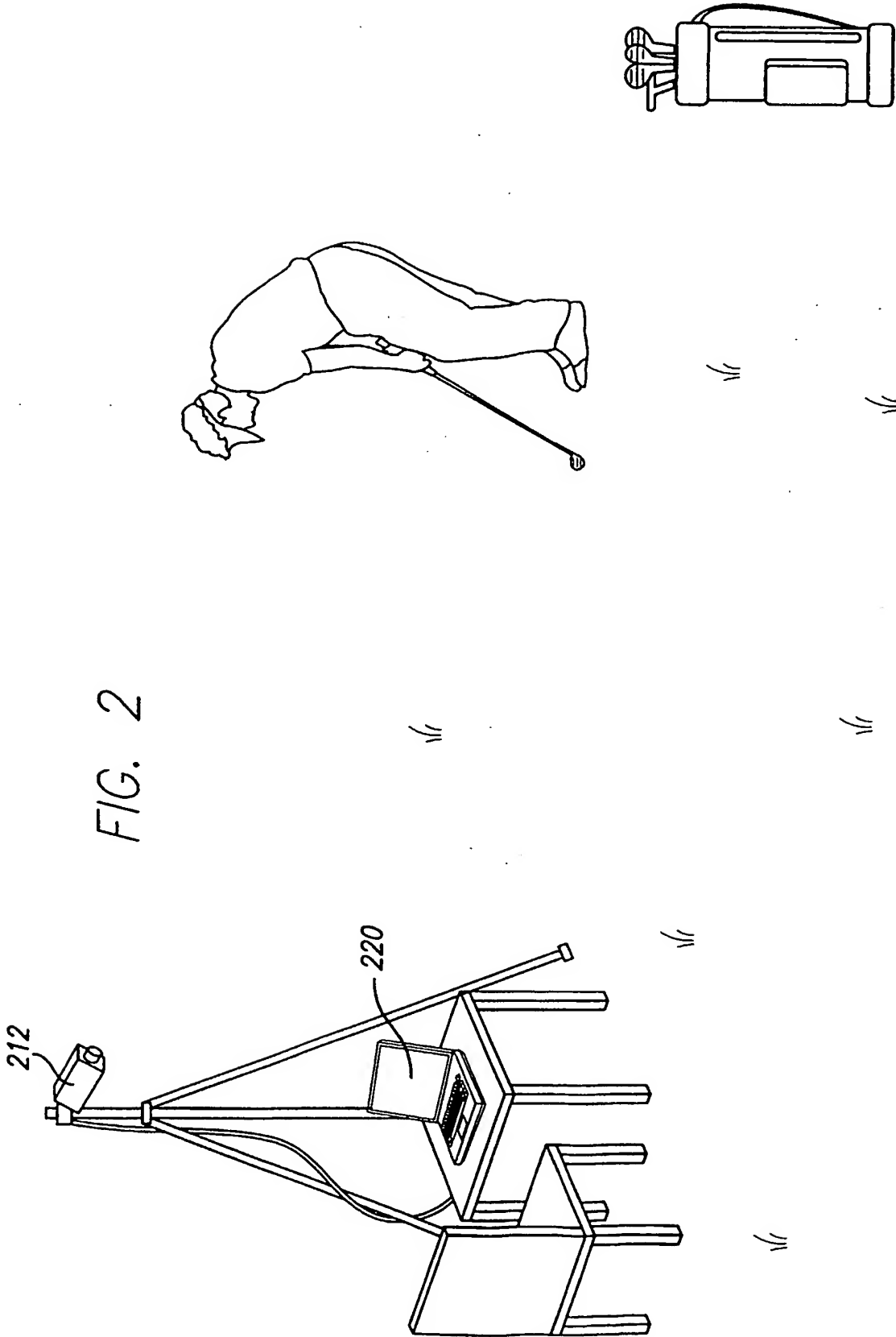
(c) selecting a performance golf club from a plurality of golf clubs based on said specific swing type of the golfer; and

5 displaying at least one specific value from said set of swing characteristics for the golfer and said selected performance golf club.

44. The fitting system as set forth in claim 43, further comprising measuring at least one of strain, acceleration, orientation or rate information for said golf club, said measurements providing additional data for analysis and
10 selection of the performance golf club for the golfer.

45. The fitting system as set forth in claim 44, further comprising capturing launch data of a golf ball upon impact with said golf club by the golfer.





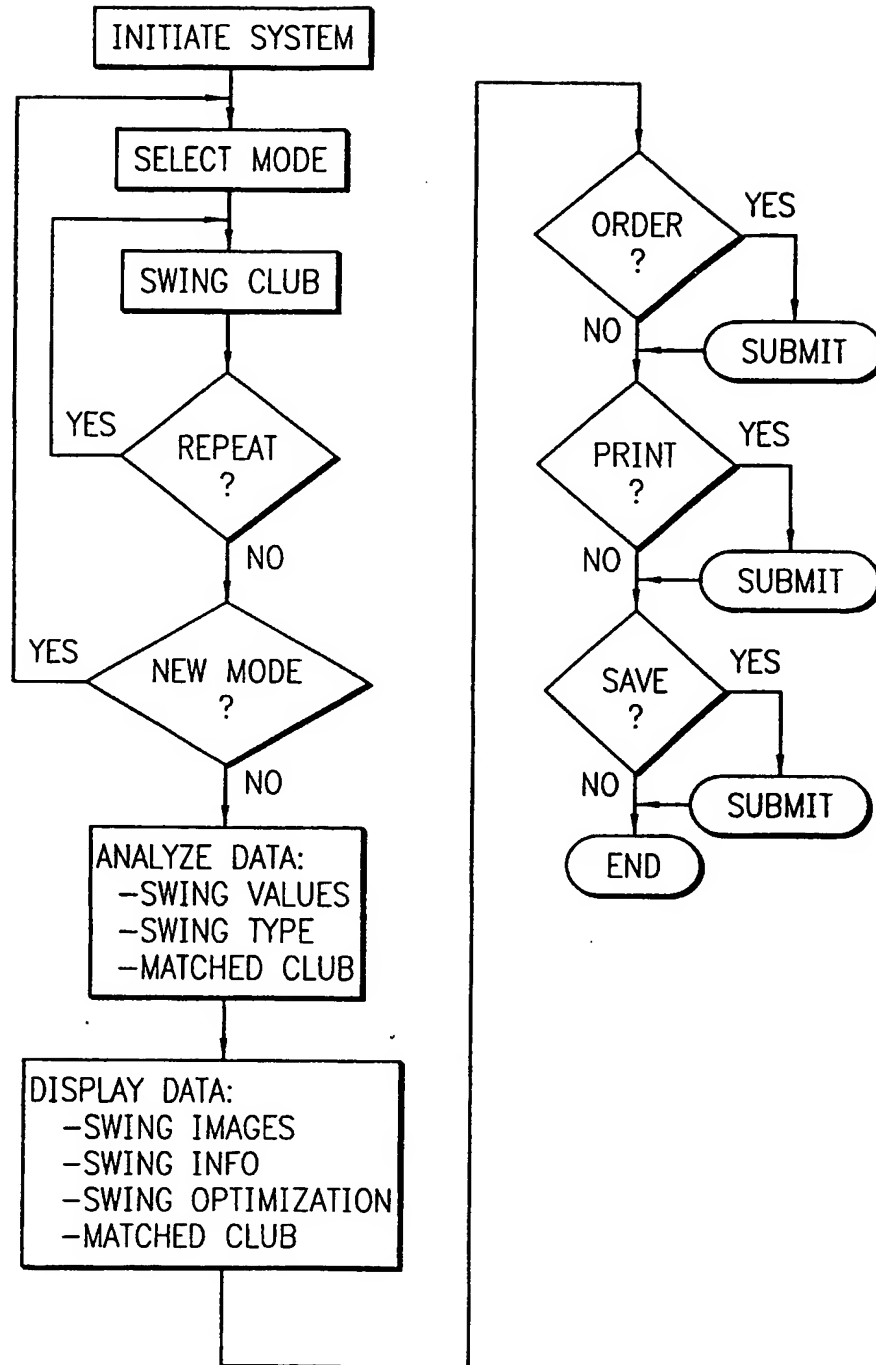


FIG. 3

FIG. 4

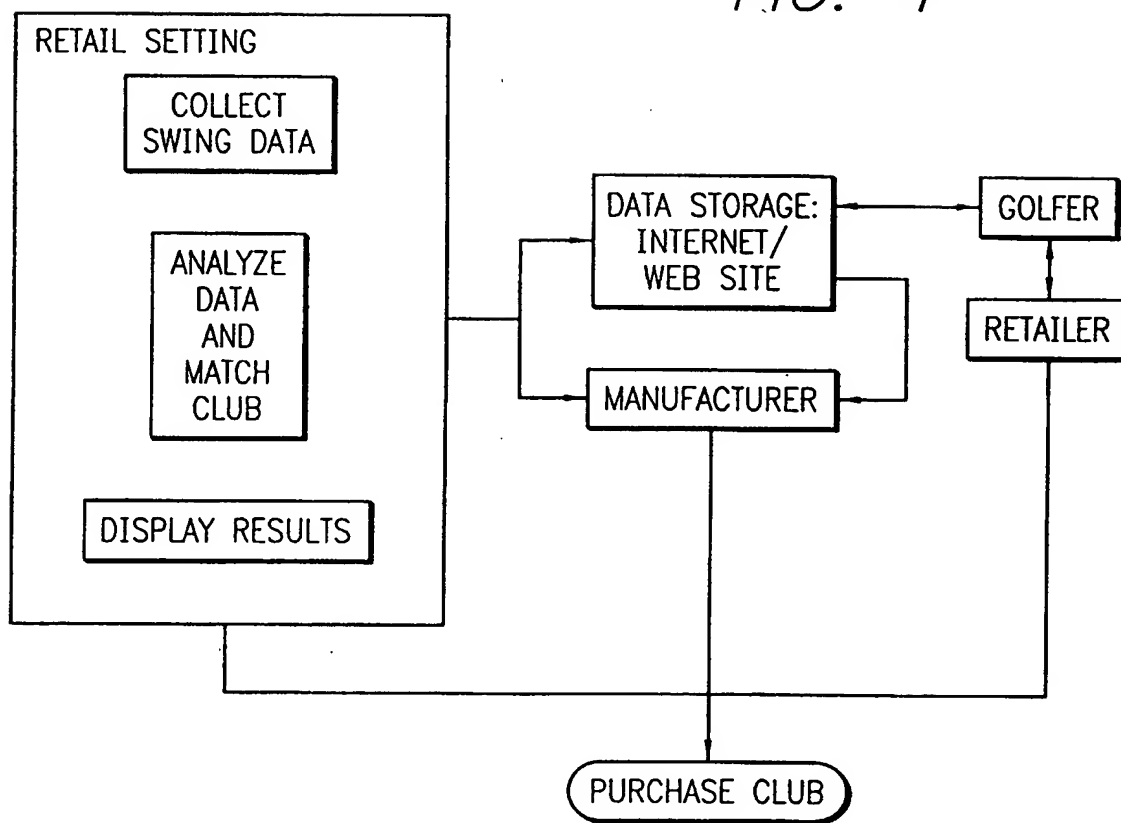


FIG. 5

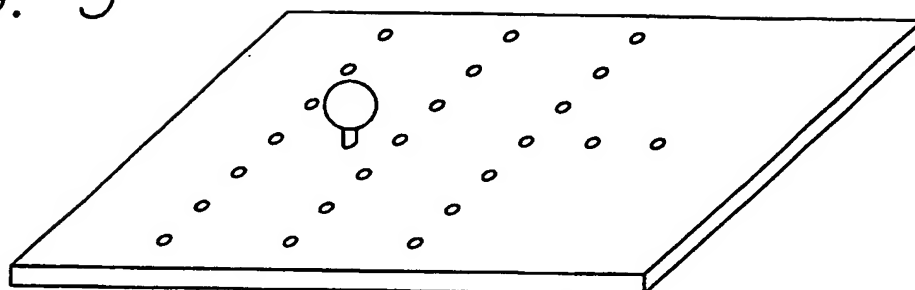


FIG. 6

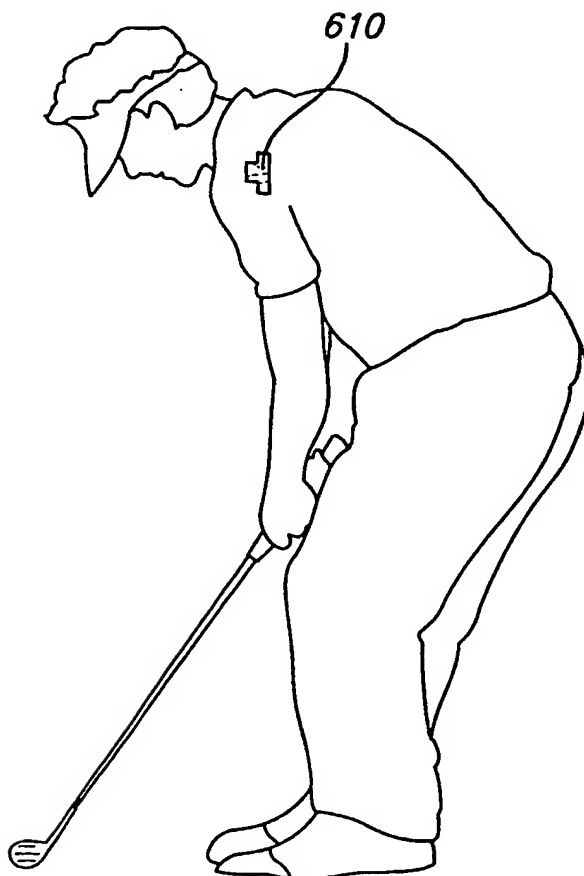


FIG. 7

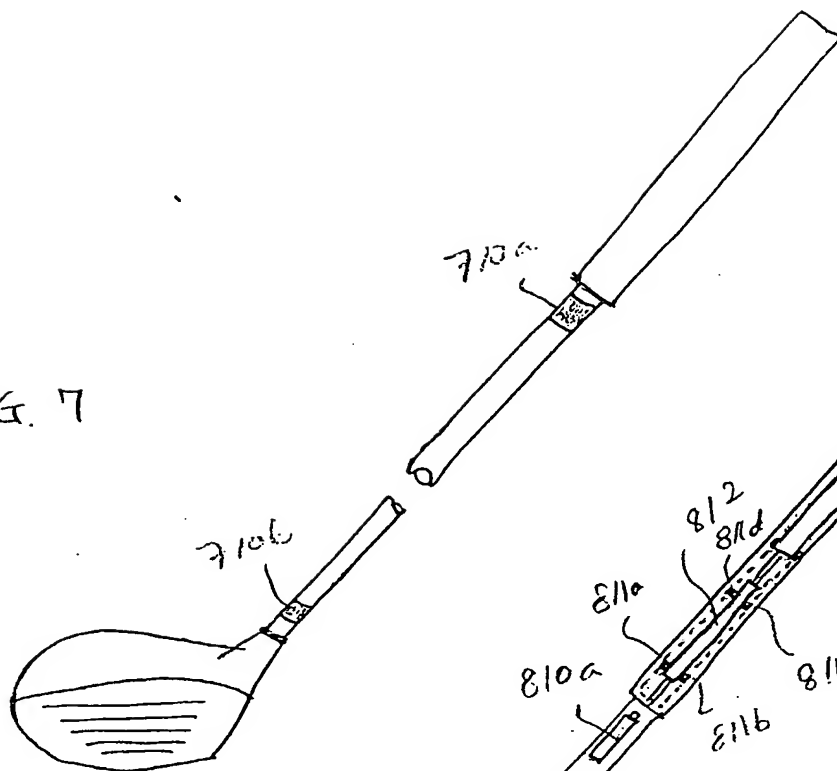


FIG. 8

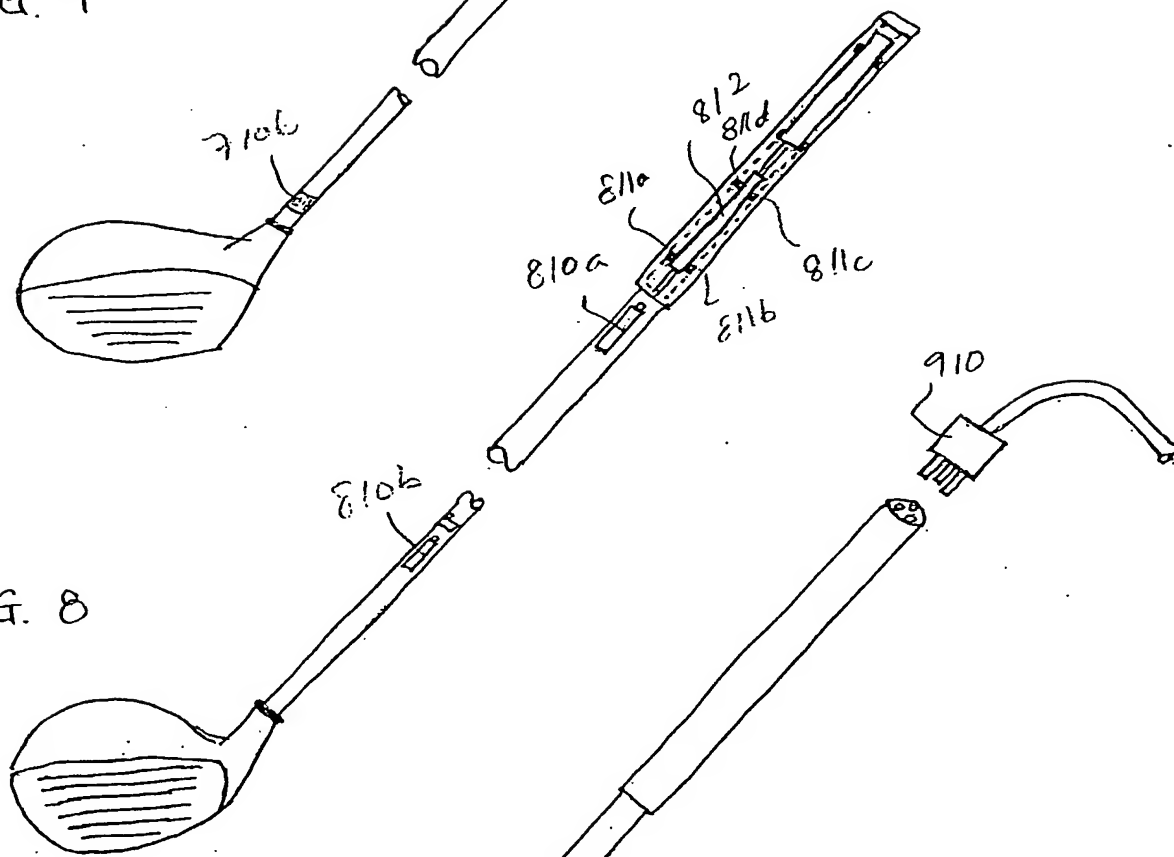
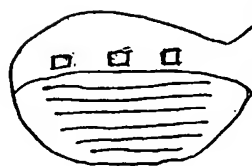


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US02/20938

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G06G 7/48; A63B 53/12

US CL : 473/199, 409

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 473/199, 409, 131, 221

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
None

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
None

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,137,566 A (HAAS et al) 30 January 1979, See the entire document.	1-45

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X"

document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search

26 September 2002 (26.09.2002)

Date of mailing of the international search report

05 NOV 2002

Name and mailing address of the ISA/US

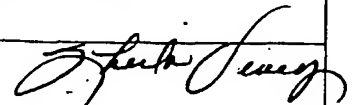
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703)305-3230

Authorized officer

M. Sager

Telephone No. 703-308-0858



(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
16 January 2003 (16.01.2003)

PCT

(10) International Publication Number
WO 03/005281 A1

(51) International Patent Classification⁷: **G06G 7/48**,
A63B 53/12

Fermi Court, Carlsbad, CA 92008-1517 (US). **STOWE, Loren**; 5545 Fermi Court, Carlsbad, CA 92008-1517 (US). **WRIGHT, Ian, C.**; 5545 Fermi Court, Carlsbad, CA 92008-1517 (US). **WHITE, Jay**; 5545 Fermi Court, Carlsbad, CA 92008-1517 (US).

(21) International Application Number: PCT/US02/20938

(22) International Filing Date: 1 July 2002 (01.07.2002)

(25) Filing Language: English

(26) Publication Language: English

(74) Agent: **CARR, John**; Sheppard Mullin Richter & Hampton LLP, 333 South Hope Street, 48th Floor, Los Angeles, CA 90071 (US).

(81) Designated States (*national*): GB, JP.

(30) Priority Data:
60/302,777 2 July 2001 (02.07.2001) US

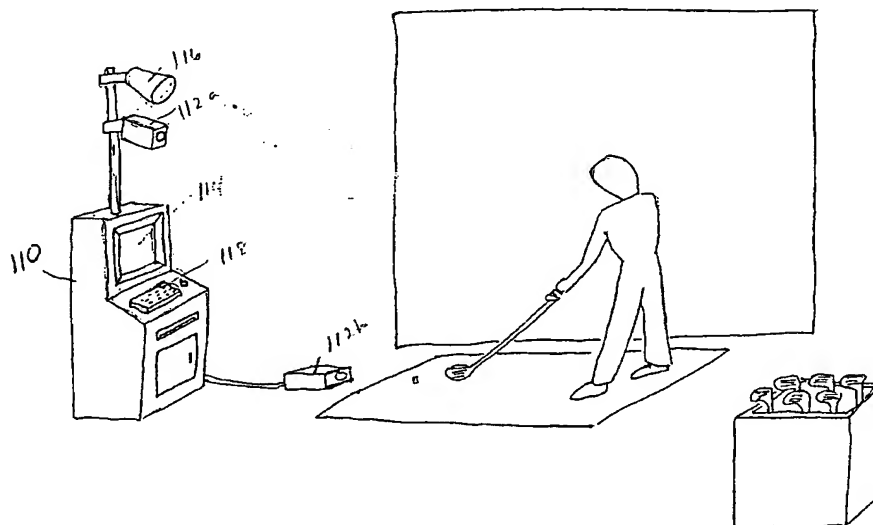
Published:
— with international search report
— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(71) Applicant: **TAYLOR MADE GOLF COMPANY, INC.**
[US/US]; 5545 Fermi Court, Carlsbad, CA 92008-1517 (US).

(72) Inventors: **ANDERSON, David**; 5545 Fermi Court, Carlsbad, CA 92008-1517 (US). **VINCENT, Benoit**; 5545

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: AUTOMATED METHOD AND SYSTEM FOR GOLF CLUB SELECTION BASED ON SWING TYPE



(57) Abstract: A method (fig. 3) of selecting a performance golf club based on a golfer's swing type is accomplished in an automated fashion and a system (figs. 1-2) that is readily and easily utilized in a retail setting, for example. The golfer performs several swings of a golf club (figs. 7-9) before a digital camera (112, 212) that transmits the golfer's swing information to a computational device (not shown) for processing. Several parameters relating to the golfer's swing characteristics are identified and a performance golf club is selected and displayed for the golfer within less than one hour (fig. 3), and preferably within about five to ten minutes. Markers (610, 710a-b, 810a-b) may be positioned on the golf club and/or the golfer for easier tracking and data collection by the system (figs. 1-2).

**AUTOMATED METHOD AND SYSTEM FOR GOLF CLUB
SELECTION BASED ON SWING TYPE**

Field of the Invention

5 The present invention relates generally to a system and method for
matching a golfer to a golf club type based upon his or her swing type
characteristics, and, specifically, to a compact, user-friendly system whereby a
golfer may quickly and automatically determine an appropriate golf club type based
10 upon swing type characteristics measured and processed within a retail location.

Background of the Invention

15 Since the origins of golf several hundred years ago, those who
participate in the game have sought to improve their performance through their
choice of equipment. In particular, an annual ritual for many golfers is the
purchase of one or more newer, improved golf clubs that "feel" better when swung
by the golfer or that at least promise some advancement in technology, whether
size, weighting, materials or something else.

20 One approach to optimizing a golfer's game is to identify a "type" of
swing of the golfer so that an appropriate golf club may be selected. Some of the
prior art systems and methods used to provide a swing type of identification for the
golfer are discussed herein.

25 U.S. Patent 4,137,566 to Haas et al. discloses a plurality of
electro-optical sensors used to capture swing data from a marked golf club and/or
golfer. The analog information is digitized and data on the positions of the golf

club and significant human body parts are stored. A coordinate transformer allows viewing of a simulated golfer at any aspect, as well as optional graphic and/or tabular displays of the data. While this system is useful for capturing the swing characteristics of the golfer, the data must be separately analyzed by an expert and the process is cumbersome and not automated.

U.S. Patent 5,111,410 to Nakayama et al. teaches the use of a video-based system which automatically measures and compares a golfer's swing to stored, reference swing data. Based upon the determined differences in the data, the closest reference data is determined and a diagnosis of the golfer's swing is made. There is also an automatic trigger mechanism which allows simple operation for use at a golf driving range, for example. This system is designed primarily as a teaching aid to improve the golfer's swing. The golfer's swing is analyzed based solely upon motion analysis.

U.S. Patent 5,342,054 to Chang et al. discloses a video-based system that includes color video cameras and an infrared camera in conjunction with image processing software and data storage in a circular buffer. In addition, compression and decompression of data is disclosed. Optionally, a sensor array is utilized and various data displays may be chosen.

U.S. Patent 5,772,522 to Nesbit et al. discloses the creation of a three-dimensional biomechanical model of a golfer which is superimposed with data of a specific golfer's swing. A plurality of markers may be used on the golfer in addition to triad markers on the club and a plurality of cameras to obtain the golfer's swing data for superposition.

U.S. Patent 6,083,123 to Wood discloses the generation of a custom set of clubs based on a club chemistry that is determined according to data obtained

on the golfer's swing. A reference club is first defined and then inferences are made with respect to club parameters to create an entire custom club set.

5 Published PCT Application WO 00/15311 A1 discloses an apparatus and method for analyzing a golfer's individual swing attributes and determining a suitable golf club configuration for that golfer. The apparatus includes video cameras for obtaining video images of a golfer's swing. The images are analyzed to determine the golf club dimensions that will provide improved results in combination with the golfer's individual swing characteristics. The golf club
10 dimensions for modification based on the analysis include loft and lie angles, for example.

 Published PCT Application WO 00/41776 A1 discloses a video capture unit for recording and displaying recorded activities such as golf. The
15 recorded activities are saved and may be separately viewed remote from the video capture unit; the activities may also be uploaded to the Internet for later viewing and analysis. Through any PC or other Internet connection, the user may input personal identification information associated with the saved images, and analysis tools may be downloaded for use with the saved images.

20 Published PCT Application WO 00/71212 A1 discloses a method of matching a golfer to a golf club and golf ball by comparing measured values to recorded sets of data. The value to be measured is clubhead speed, and the sets of data for comparison include golf club loft angle, shaft flex, golf ball weight and ball
25 spin.

 U.S. Patent 6,086,487 to Morgan et al. discloses the use of web sites to query a user for information on his or her style of play that is compared to stored information to return a predetermined selection for a golf ball.

Published PCT Application WO 01/28644 A1 discloses a method and system for teaching a skill such as golf to a student. The system includes cameras to create a series of images representative of the student performing the skill. The images are stored in digital format by a computer system so that they are accessible from a telecommunication network, such as the Internet. An expert in the skill then accesses the images, examines them, and creates a series of annotated digital images of the student performing the skill. The annotated digital images are stored for later access by the student via the telecommunication network.

The techniques described above suffer from various disadvantages, including but not limited to a reliance on expert (human) assistance, expensive or complex hardware, inconvenience due to limited availability of the system, and data formats that may be difficult to interpret for selecting a golf club. Thus, there exists a need for a system and method for the quick and easy measuring a golfer's swing characteristics and identifying the golfer's swing type in a convenient location, such as a local driving range or golf course pro shop, for the purpose of determining an ideal club type for purchasing.

Brief Description of the Drawings

FIG. 1 illustrates a preferred embodiment of the system of the present invention as located within a retail setting such as a pro shop at a golf course.

5

FIG. 2 illustrates a second preferred embodiment of the system of the present invention as located outdoors such as at a golf course or driving range.

10

FIG. 3 is a flowchart showing a possible sequence of steps employed in a method of the present invention.

FIG. 4 is a flowchart showing a possible sequence of steps employed in an alternative method of the present invention.

15

FIG. 5 shows an alternative device for collection of data in the system of the present invention.

FIG. 6 shows a golfer having markers in accordance with an embodiment of the present invention.

20

FIG. 7 shows a golf club used in carrying out the club selection process of the present invention.

25

FIG. 8 shows an alternative golf club used in carrying out the club selection process of the present invention.

FIG. 9 shows yet another alternative golf club used in carrying out the club selection process of the present invention.

Detailed Description of the Preferred Embodiments

5 A first preferred embodiment of a system and method of the present invention is illustrated in FIG. 1. As shown, the system includes a kiosk 110 having at least one digital camera coupled thereto 112 and further including a display monitor 114. The kiosk is possibly set up inside a golf shop, the golf shop located either on or off a golf course. The system will also preferably include a light source 116 and a key pad or keyboard 118 for accepting input into the system. The kiosk includes a fully functional computer with digital signal processor. The camera is used to capture "swing" characteristics of a golfer as the golfer swings a club. These "swing" characteristics are processed by the digital signal processor within the kiosk and a preferred club for the golfer is selected and displayed on the monitor. In a preferred embodiment, the camera is capable of capturing data at a rate of at least 60 Hz.

15
20 FIG. 2 shows a second preferred embodiment of a system of the present invention wherein at least one digital camera 212 is coupled to a laptop computer 220 which includes a display. The camera and laptop are both stationed outdoors. The laptop is then networked and/or wirelessly coupled to a remotely located kiosk 110. The camera 212 and laptop 220 are used to capture "swing" characteristics of a golfer as the golfer swings a club. These "swing" characteristics are then transmitted to the remotely located kiosk, where they are then processed by the digital signal processor. In a preferred embodiment, the camera is capable of capturing data at a rate of at least 60 Hz. A preferred club for the golfer is then selected and displayed on the laptop display.

25
In either of the physical settings of FIGS. 1 or 2, a method of the present invention for matching a golfer with a preferred club based upon collected

swing characteristics is presented as a flowchart of FIG. 3. Preferably, the method includes the steps of:

providing a swing data collection system, said swing data collection system comprising a golf club and at least one digital camera, said golf club comprising a shaft with a grip end and a tip end having a club head attached thereto, said shaft having at least two markers thereon;

having the golfer swing said golf club at least one time;

using the digital camera to collect data about the golfer's swing, said data representing a plurality of positions of said markers occurring during said at least one swing;

providing an automated data analyzer to analyze said data, said data analyzer

(A) processing said data to determine specific values for a set of swing characteristics for the golfer, said data analyzer saving said specific values for the golfer in a memory; and

(B) selecting a performance golf club from a plurality of golf clubs based on said specific values for the golfer

The system then displays the data collected along with the selected performance club which best matches the specific values for the set of swing characteristics. The data may be displayed in either graphical or numerical form. The system may also be configured to play back the images captured by the digital camera.

Preferably, at least one marker is positioned adjacent the grip end of said golf club and at least one additional marker is positioned adjacent the club head at the tip end of said golf club. The markers may include reflective tape, light sources, or bands of one or more colors. In a preferred embodiment, a single video camera captures two dimensional data and this two dimensional data is transformed

into data representing three dimensional “swing” characteristics for the golfer, said three-dimensional data correlated to said set of swing characteristics. The mathematical analysis of the pixel data from a digital camera to accomplish the 2-D to 3-D transformation, or vice-versa, is performed using any method known to those skilled in the art.

In an alternative method of the present invention, a “markerless” tracking of natural features of the golf club, golfer and/or golf ball may be employed. That is, artificial features such as reflective tape are not used, and instead a pattern recognition technique may be used for the markings of a golf ball, for example. The glove, club head, grip, etc. may be discerned without markers by discriminating between the natural features and the other, background images.

In a preferred embodiment, the system includes means for triggering initiation of the capture of swing characteristics and further means for notifying the golfer of the state of such data collection. In a preferred embodiment, the system includes a key pad which includes a start key. The start key initiates a timer red-yellow-and-green lights or LED’s included with the system indicate the status of the system. Preferably, a yellow light indicates that the system is preparing to capture or collect swing characteristics. When the system is in this mode, the golfer will preferably begin to prepare to swing the club and have his swing characteristics measured. When the light turns green, video capture is initiated and the golfer will take his swing and have the data which represent his swing characteristics collected by the system. When the LED indicators are red the system is not operating or is processing data and cannot be used to collect any more video.

In an alternative embodiment, the data collection system used to collect the golfer “swing” characteristics includes two digital cameras arranged to

capture three dimensional data. In this embodiment, the data analysis correlates actual three-dimensional data captured by said at least two cameras into a set of swing characteristics and determines a preferred club type based upon these known swing characteristics.

5

In a preferred embodiment, the data collection, analysis and display occur within a specific time frame of less than about one hour. Alternatively, the data collection, analysis and display can all occur within a specific time frame of less than about 10 minutes. An advantage of the present invention is the ability to provide data collection, analysis and display of club selection results quickly – nearly “real-time” – to a golfer/consumer. Thus, with faster computation speeds according to the equipment used, the actual time frame is easily within a quick trip to the pro shop, for example.

10

15

In a preferred embodiment, the system and method of the present invention includes a memory and the ability to save said data of the golfer's swing in said memory, said method further comprising an additional step of transmitting the content of said memory via the internet to a web site for later remote access. Preferably, the data maybe compressed and encoded prior to saving it in said memory.

20

The data or “swing” characteristics collected and processed in the present invention may be utilized in an additional aspect of the present invention, as illustrated in the flowchart of FIG. 4. As shown in FIG. 4, the data may be stored and retrieved at any later time when the golfer is ready to purchase a new club from the retailer. Alternatively, the data may be transmitted to a manufacturer such that a customize golf club may be designed to match the golfer's measured swing characteristics.

25

In a preferred embodiment, a minimum of two types of data should be collected in determining a golfer's swing characteristics, such as club head speed and shaft flex, for example. In alternative embodiments, additional sensors may be used such that additional information may also be collected such as ball flight data including launch angle, or club head orientation at time of impact with the ball surface. Sensors which may be used with the golf club would include, for example, rate gyros, accelerometers, orientation sensors, strain gauges and magnetic components. The methods of applying these sensors to a club and their preferred locations are known to those skilled in the art. Miniaturization of components in particular provide the opportunity to place and use the sensors with minimal effect on the golfer's swing.

In an alternative embodiment, sensors external to the golf club may be used to measure the club movement and angle. FIG. 5 shows an embodiment wherein a mat having sensors in a fixed configuration is used to obtain club head speed and position information as the club is swung over the mat. The sensors comprise arrays of light emitters and receivers, where the light is reflected from the club head as it passes over the mat. The club head information which may be collected in the this embodiment would include such statistical information as face angle of the club and speed of the club just prior to impact with the golf ball.

In a further preferred embodiment, actual movement of the golfer himself may be measured to determine his or her swing type. This additional embodiment of the present invention is shown in FIG. 6. As shown, a golfer has specific parts of his or her upper torso marked to provide additional information for analyzing the swing characteristics, according to the desired set of swing characteristics to be used in the analysis. In this illustration, one or both shoulders and/or one or both hips may have reflective tape attached. Alternatively, clips or the like may be used to attach additional or other types of marking devices for

swing data collection. In this embodiment, a second digital camera is focused on the golfer and is used to capture information about the movement of the golfer. This information is also processed in order to more accurately determine the golfer's swing type and match him or her with a preferred club.

5

FIGS. 7-9 illustrate various embodiments for an instrumented golf club for swing data collection. Passive means, such as reflective tape, may be used and positioned at different points on the golf club 710a-b, as shown in FIG. 7. Alternatively, a more active means requiring a power source may be used. FIG. 8 shows a club having strain gauges 810a-b provided on the surface of the golf shaft and other sensors 811a-d provided on a sensing member 812 that is received within the grip end of the golf club. A battery may be included with the member as a power source, and the data may be stored in a memory element of the member or may be transmitted to a remote location via radio frequency transmission or the like to deliver the data for storage and analysis. Alternatively, the end of the golf club grip may be adapted to receive an interface 910 which links directly to a data storage and/or computing device, as shown in FIG. 9. This cable link may be removable or remain attached as the golfer swings the club.

10

15

20

25

One type of camera that may be used for data collection is available from Cognex in Needham, Massachusetts or Vision Components in Ettlingen, Germany, for example. This digital camera not only captures data but has an internal CPU unit co-located in its housing to perform all or part of the data analysis. The camera may then be directly linked to a display unit to present the golfer's swing information and/or club selection results. Alternatively or additionally, the camera may be linked to a separate computing device for data storage and/or transfer, for example, over the internet.

5 The transmission of the data collected from the sensors may be performed using a fiber optic, cable or USB link, infrared methods or radio frequency techniques. The computing devices available for processing include, for example, personal digital assistants (PDA's), laptop computers, desktop computers and point-of-purchase (POP) kiosk units. The arrangement of the data transmission connection and computing device is variable and may be designed in consideration of local space and/or power constraints as well as cost.

10 EXAMPLES OF SYSTEMS FOR SWING ANALYSIS/TYPE IDENTIFICATION:

15 The analysis of the golfer's swing characteristics may be performed utilizing swing information gathered as disclosed in U.S. Patents 3,792,863, 3,945,646 and 4,615,526, for example. These methods include various golf club configurations to capture information such as swing speed, club head acceleration and face angle at approach as well as shaft flex and torque. In addition, data relating to an individual's characteristic golf swing and ball launch conditions may be obtained in the manner disclosed in U.S. Patent 4,375,887, *e.g.*, using a video system to capture swing and ball launch data from the golfer. These prior swing data collection methods all are specified for use as training aids, to provide feedback to improve the golfer's swing. In the present invention, on the other hand, such methods may be employed in conjunction with at least one digital camera, as part of a club collection process.

25 Although data collection of a golfer's swing information may be done with direct video display of the golfer's image, alternatively a virtual representation of the golfer may be substituted. This image would be the result of having included the golfer's physical characteristics into a program already having fixed physical features accounted for in the data analysis. Thus, hair color, facial features, clothing and other such details could remain constant from golfer to golfer, but the

actual motion of the golfer's swing would be customized.

Exemplary methods to determine an appropriate golf club shaft type for the golfer are disclosed in U.S. Patents 5,821,417 and 6,213,888. In the former patent, shaft selection is based upon values obtained for shaft strain as well as combinations of data including shaft strain and swing speed, club acceleration and speed at impact, club speed at the top of the swing and at impact, and swing time and speed at impact. In the latter patent, three strain gauges are located on the golf club to determine appropriate shaft torque and/or kick point for the golfer leading to a choice from four types of golf club shafts.

Alternatively, determination of an optimum golf club type according to a golfer's swing characteristics may be accomplished according to a method disclosed in a co-pending and commonly assigned patent application entitled "Method of Matching Swing Type to Golf Club Style," filed on April 3, 2002, Serial No. 10/116,688. That application is incorporated by reference herein. Generally, a set of performance parameters and associated value ranges are determined such that the golfer's specific values may be correlated to an optimum club type for him or her. Additional parameters are used to further refine the club, such as loft and lie. The present invention allows the golfer to have his or her swing data processed in an automated manner such that he or she may quickly determine an appropriate golf club specifically matched to his or her swing type and immediately available for purchase.

Although the invention has been disclosed in detail with reference only to the preferred embodiments, those skilled in the art will appreciate that additional automated golf club fitting systems and methods of accomplishing same can be made without departing from the scope of the invention. Accordingly, the invention is only intended to be limited by the claims included herewith.

THE CLAIMS

What is claimed is:

5 1. A method of selecting a performance golf club from a plurality of golf clubs based on a golfer's swing characteristics, comprising:

 providing a swing data collection system, said swing data collection system comprising a golf club and at least one digital camera 112, said golf club comprising a shaft with a grip end and a tip end having a club head attached thereto, said shaft having at least two markers 710a-b thereon;

 having the golfer swing said golf club at least one time;

 collecting data about the golfer's swing using said camera, said data representing a plurality of positions of said markers occurring during said at least one swing;

15 providing an automated data analyzer 110 to analyze said data, said data analyzer

 (A) processing said data to determine specific values for a set of swing characteristics for the golfer, said data analyzer saving said specific values for the golfer in a memory; and

20 (B) selecting a performance golf club from a plurality of golf clubs based on said specific values for the golfer; and displaying said selected performance golf club.

25 2. The method as set forth in claim 1, further comprising locating at least one marker 710a adjacent the grip end of said golf club and at least one marker 710b adjacent the club head at the tip end of said golf club.

 3. The method as set forth in set claim 2, further comprising providing an illumination source 116 located near said camera, wherein said

markers comprise reflective tape.

4. The method as set forth in claim 2, wherein said markers comprise light sources.

5. The method as set forth in claim 2, wherein said markers comprise bands of one or more colors.

6. The method as set forth in claim 1, wherein said camera 112 is capable of capturing data at a rate of at least 60 Hz.

7. The method as set forth in claim 1, wherein the data analysis performed by said data analyzer comprises transforming two-dimensional data to data representing three dimensions, said three-dimensional data correlated into said set of swing characteristics.

8. The method as set in claim 1, wherein the data analysis performed by said data analyzer comprises correlating two-dimensional data into said set of swing characteristics.

9. The method as set forth in claim 1, wherein said swing data collection system comprises at least two digital cameras 112a-b, the data analysis performed by said data analyzer 110 comprising correlating three-dimensional data captured by said at least two cameras to said set of swing characteristics.

10. The method as set forth in claim 1, wherein the data collection, analysis and display occur within a specific time frame of less than about one hour.

11. The method as set forth in claim 1, wherein the data collection, analysis and display occur within a specific time frame of less than about 10 minutes.

5 12. The method as set forth in claim 1, wherein said data analyzer comprises a laptop computer 220 and said method further comprises transmitting said data via a cable link from said camera 212 to the laptop computer, said displaying of said selected performance golf club is on a monitor for the laptop computer.

10 13. The method as set forth in claim 12, further comprising:
transmitting said data via a cable link or wireless connection to a kiosk, said kiosk comprising a computational device and viewing screen; and
15 displaying of the selected performance golf club on said screen.

14. The method as set forth in claim 13, wherein said data analyzer comprises a digital signal processor located within said kiosk.

20 15. The method as set forth in claim 13 wherein the data analysis further comprises:
saving said data of the golfer's swing in a memory located within said kiosk, and
25 transmitting the content of said memory via the internet to a web site for later remote access.

16. The method as set forth in claim 15, wherein the data analysis further comprises encoding said data prior to saving it in said memory.

17. A method of selecting a performance golf club from a plurality of golf clubs based on swing characteristics for a golfer, comprising:

providing a swing data collection system, said swing data collection system comprising at least one golf club and at least one digital camera 112, said
5 golf club comprising a shaft with a grip end and a tip end having a club head attached thereto, and said shaft having at least two markers 710a-b thereon;

having the golfer swing said golf club at least one time;

collecting data about the golfer's swing using said camera,

comprising:

10 transmitting said data to an automated data analyzer;

correlating said data to specific values for a predetermined set of swing characteristics, said set of swing characteristics categorized into a plurality of swing types, said plurality of swing types associated with the plurality of golf clubs from which a performance golf club is chosen; and

15 displaying said performance golf club chosen according to said specific values.

18. The method as set forth in claim 17, further comprising displaying at least one of said specific values of said swing characteristics for the golfer.

20 19. The method as set forth above in claim 17, further comprising displaying each of said plurality of golf clubs and each of said plurality of swing types associated therewith.

25 20. The method of claim 17, further comprising displaying a set of values for each of said predetermined set of swing characteristics for each of said plurality of swing types.

21. A kiosk 110 and video fitting system for selecting a performance golf club for a golfer from a plurality of golf clubs based on the golfer's swing characteristics, said fitting system located in a retail location, said fitting system comprising:

5 at least one digital camera 112;
 at least one golf club, a golfer swinging said golf club in front of said
 camera to provide data for analysis and club selection;
 an digital signal processor, said digital signal processor processing
 said data and determining specific values for a predetermined
10 set of swing characteristics for the golfer, said kiosk then
 saving at least said data and said specific values in a memory,
 said kiosk providing as an output a selected performance golf
 club; and
said kiosk comprising a housing containing at least said digital signal processor and
15 a keypad 118 for entry of commands to control at least said camera 112 and said
 data analyzer, said kiosk further included a display 114 adapted to display said
 output of the golf club selection.

22. The fitting system as set forth in claim 21, wherein said fitting system is operated by the golfer.

20 23. The fitting system as set forth in claim 21, wherein said kiosk
 further displays said saved data of the golfer's swing.

24. The fitting system as set forth in claim 23, wherein said kiosk provides a printout of at least one of said specific values and said output of the golf club selection.

25. The fitting system as set forth in claim 21, wherein said kiosk is adapted to communicate the content of said memory over the internet for later remote access.

5 26. The fitting system as set forth in claim 21, wherein said golf club further comprises at least one sensor 810 selected from the group including a strain gauge, an angular rate sensor, an orientation sensor and an acceleration sensor, said at least one sensor providing additional data for analysis and selection of the performance golf club for the golfer.

10 27. The fitting system a set forth in claim 21, wherein said golf club has a first marker 710a located toward a grip end and a second marker 710b located toward a tip end having a club head.

28. The fitting system as set forth in claim 27, wherein said markers comprise reflective tape and said fitting system further comprises an illumination source 116 located near said camera.

15 29. The fitting system as set forth in claim 21, wherein said camera captures images representing a launch trajectory of a golf ball upon impact with said golf club by the golfer.

30. A method of selecting a performance golf club from a plurality of golf clubs based on a golfer's swing characteristics, comprising:

20 providing a swing data collection system, said swing data collection system comprising at least one golf club and at least one digital camera 112, each of said at least one golf club comprising a shaft with a grip end and a tip end having a club head attached thereto;

having the golfer swing each of said at least one golf club at least one

time;

collecting data about the golfer's swing using said camera, said data including images representing a plurality of positions of said at least one golf club occurring during said at least one swing;

5 providing a digital signal processor, said digital signal processorata analyzer

(a) processing said data to determine specific values for a predetermined set of swing characteristics for the golfer, said swing data collection system then saving said specific values for the golfer in a memory;

10 (b) categorizing the golfer as a specific swing type from a plurality of swing types; and

(c) selecting a performance golf club from a plurality of golf clubs based on said specific swing type of the golfer; and

15 displaying said selected performance golf club.

31. The method as set forth in claim 30, further comprising the additional step of attaching a first marker 610 to at least one location on the golfer prior to having the golfer swing said at least one golf club at least one time.

32. The method as set forth in claim 31, wherein said marker is
20 attached to a location on the upper torso of said golfer.

33. The method as set forth in claim 31, further comprising the additional step of attaching a second marker 710a to at least one location on each of said at least one golf club prior to having the golfer swing each of said at least one golf clubs.

34. The method as set forth in claim 31, wherein said first marker comprises reflective tape and said swing data collection system further comprises an illumination source 116 located near said camera 112.

5 35. The method as set forth in claim 33, wherein said second marker comprises reflective tape and said swing data collection system further comprises an illumination source 116 located near said camera 112.

36. A method of selecting a performance golf club from a plurality of golf clubs based on a golfer's swing characteristics, comprising:

10 providing a swing data collection system, said swing data collection system comprising at least one golf club and at least one digital camera, each of said at least one golf club comprising a shaft with a grip end and a tip end having a club head attached thereto;

having the golfer swing each of said at least one golf club at least one time;

15 collecting data about the golfer's swing using said camera, said data including images representing a plurality of positions of said at least one golf club occurring during said at least one swing;

providing an automated data analyzer, said data analyzer

20 (a) processing said data to determine specific values for a predetermined set of swing characteristics for the golfer, said data analyzer saving said specific values for the golfer in a memory;

(b) categorizing the golfer as a specific swing type from a plurality of swing types; and

25 (c) selecting a performance golf club from a plurality of golf clubs based on said specific swing type of the golfer; and displaying a first sequence of images showing the golfer during said

at least one swing;

displaying a second sequence of images showing said specific swing type of the golfer; and

displaying said selected performance golf club.

5 37. The method as set forth in claim 36, further comprising displaying a plurality of image sequences corresponding to each of the plurality of swing types.

38. The method as set forth in claim 37, wherein said displaying of said first and second sequences is an overlay of the images.

10 39. The method as set forth in claim 37, wherein said displaying of said first sequence comprises overlaying said first sequence with each of said plurality of image sequences, such that the swing of the golfer is compared with each of the swing types.

15 40. A video fitting system for selecting a performance golf club for a golfer from a plurality of golf clubs based on the golfer's swing characteristics, said fitting system located in a retail location, said fitting system comprising:

at least one digital camera 112;

at least one golf club, a golfer swinging said golf club in front of said camera to provide data for analysis and club selection;

20 an automated data analyzer for processing said data and determining specific values for a predetermined set of swing characteristics for the golfer, said data analyzer saving at least said data and said specific values in a memory, said data analyzer providing as an output a selected performance golf club; and

25 a kiosk for housing said data analyzer, said kiosk including a keypad 118 for entry of commands to control at least said camera and said data analyzer,

said kiosk further including a display 114 adapted to display said output of the golf club selection.

41. The fitting system as set forth in claim 40, wherein said data analyzer further provides as a second output at least one swing characteristic from said set of swing characteristics.

42. The fitting system as set forth in claim 40, wherein said golf club comprises at least one sensor 810 for measuring strain, acceleration, orientation or rate information for said golf club, said at least one sensor providing additional data for analysis and selection of the performance golf club for the golfer.

43. A method of selecting a performance golf club from a plurality of golf clubs based on a golfer's swing characteristics, comprising:

providing a swing data collection system, said swing data collection system comprising at least one golf club and at least one digital camera, each of said at least one golf club comprising a shaft with a grip end and a tip end having a club head attached thereto;

having the golfer swing each of said at least one golf club at least one time;

collecting data about the golfer's swing using said camera, said data representing a plurality of positions of said at least one golf club occurring during said at least one swing;

providing an automated data analyzer, said data analyzer

(a) processing said data to determine specific values for a predetermined set of swing characteristics for the golfer, said data analyzer saving said specific values for the golfer in a memory;

(b) categorizing the golfer as a specific swing type from a plurality of swing types; and

(c) selecting a performance golf club from a plurality of golf clubs based on said specific swing type of the golfer; and

5 displaying at least one specific value from said set of swing characteristics for the golfer and said selected performance golf club.

44. The fitting system as set forth in claim 43, further comprising measuring at least one of strain, acceleration, orientation or rate information for said golf club, said measurements providing additional data for analysis and
10 selection of the performance golf club for the golfer.

45. The fitting system as set forth in claim 44, further comprising capturing launch data of a golf ball upon impact with said golf club by the golfer.

FIG. 1

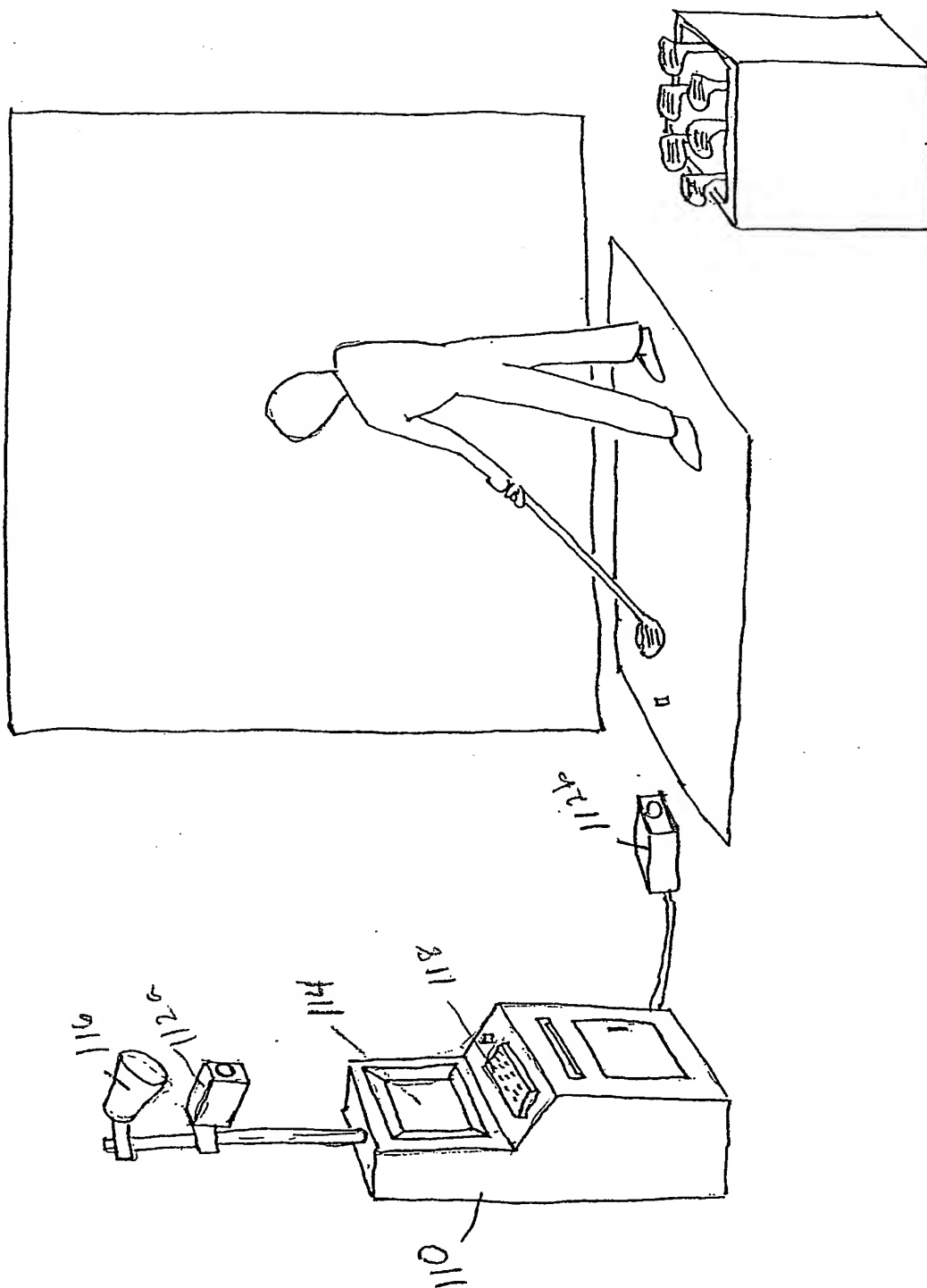
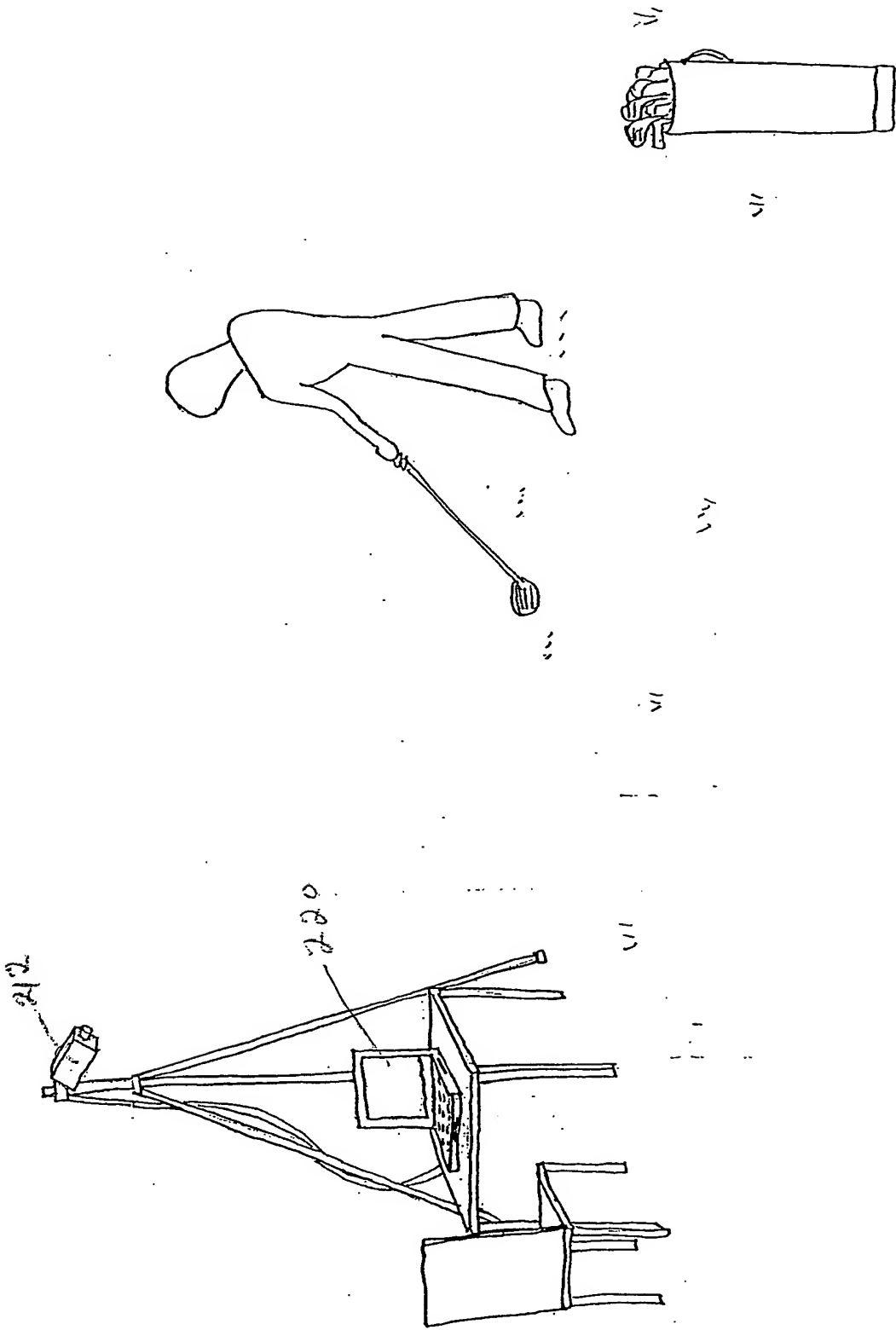


FIG. 2



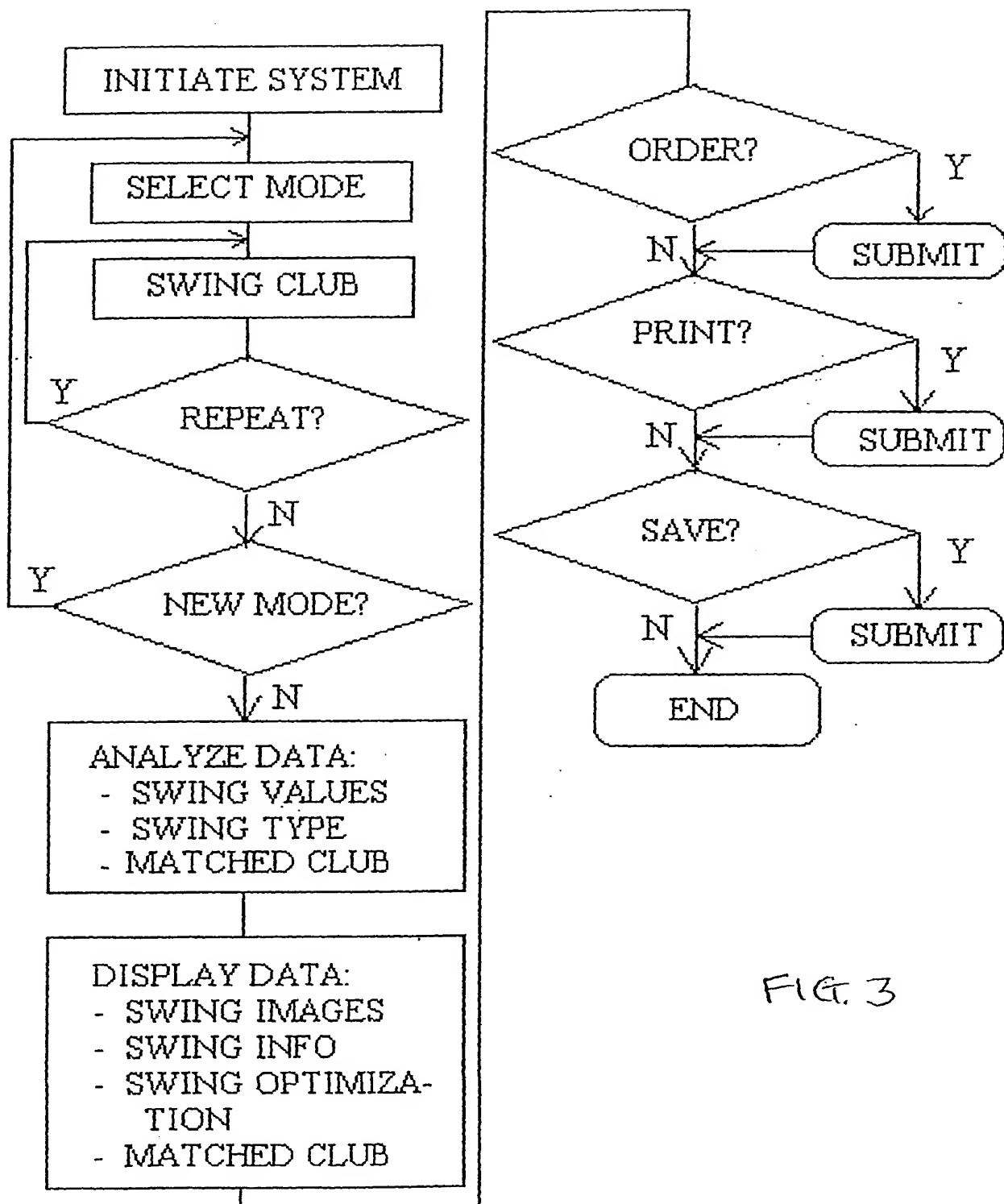
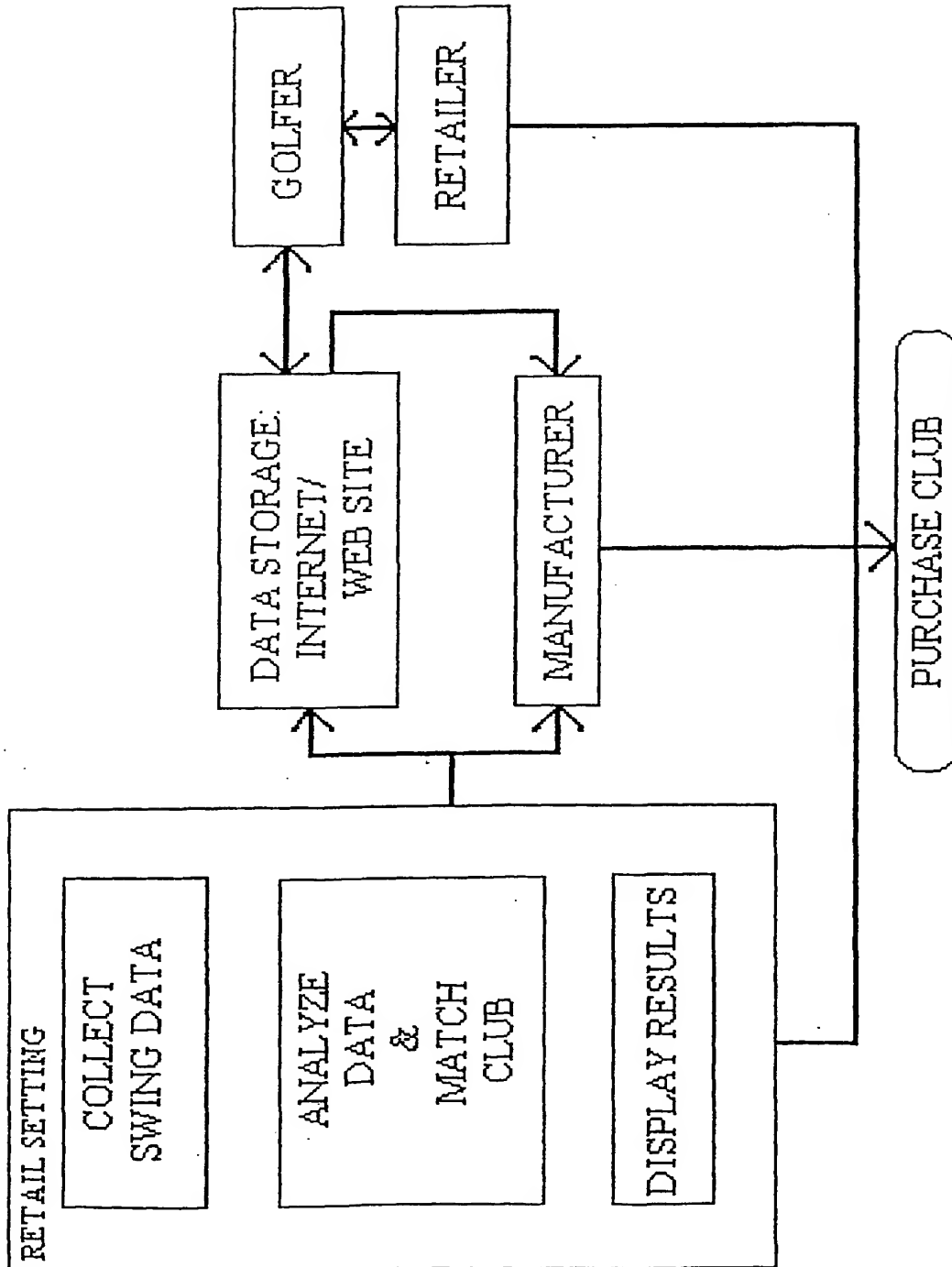


FIG. 3

FIG. 4



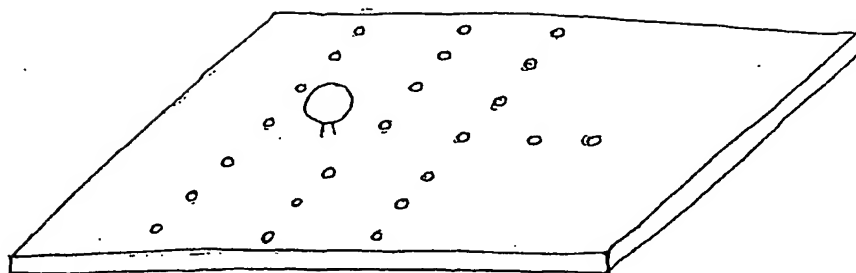


FIG. 5

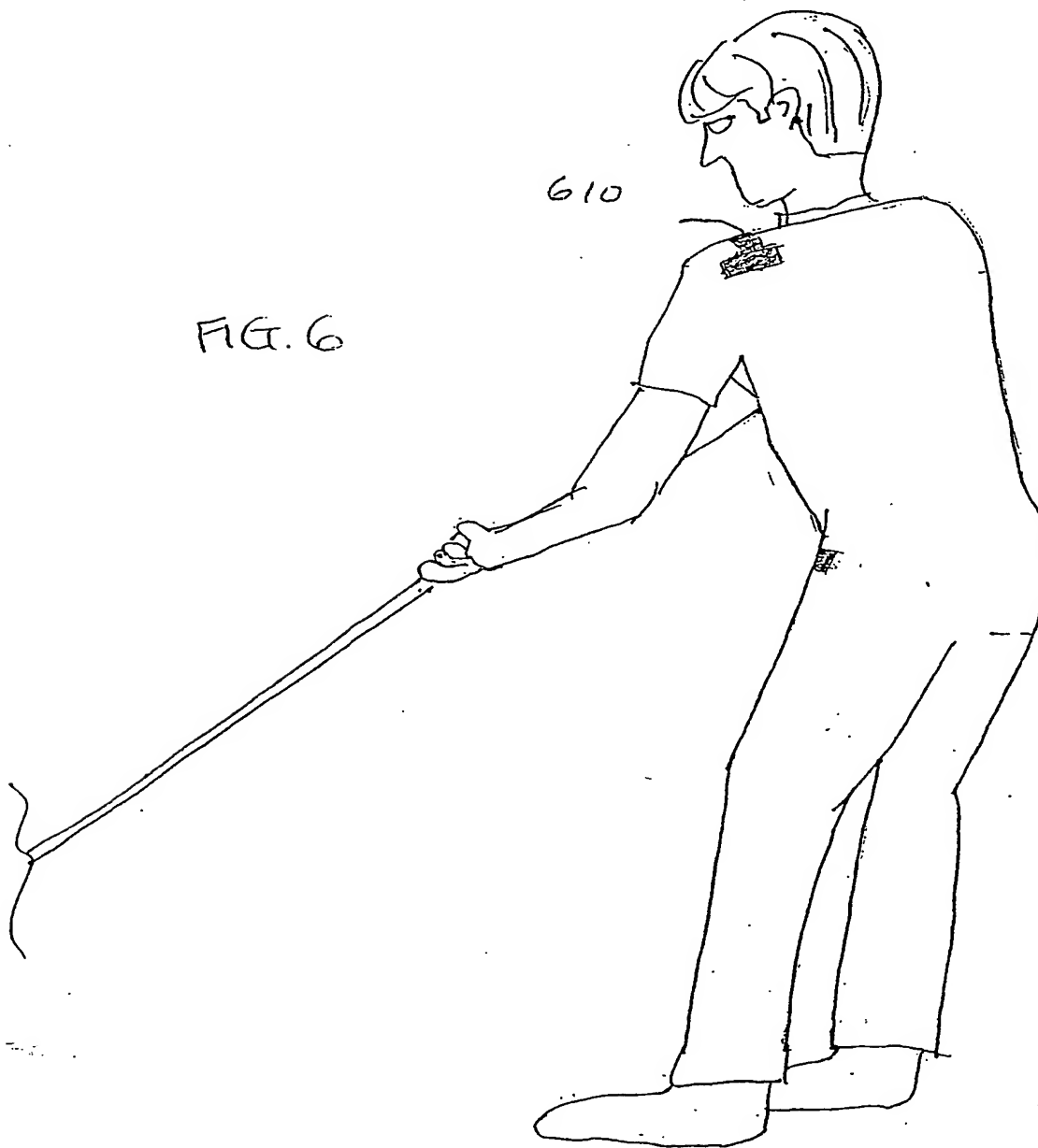


FIG. 6

FIG. 7

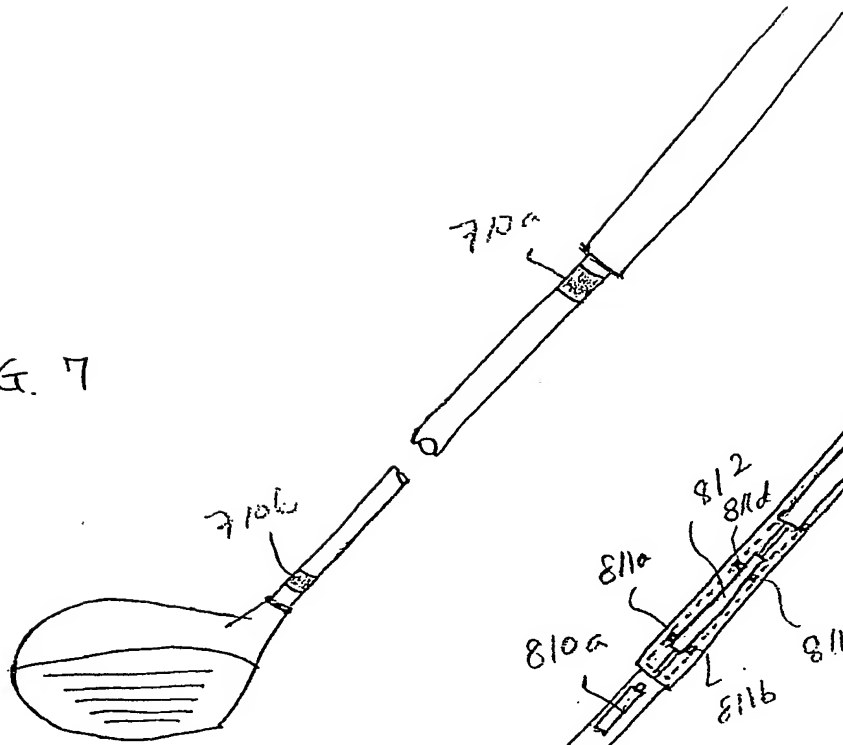


FIG. 8

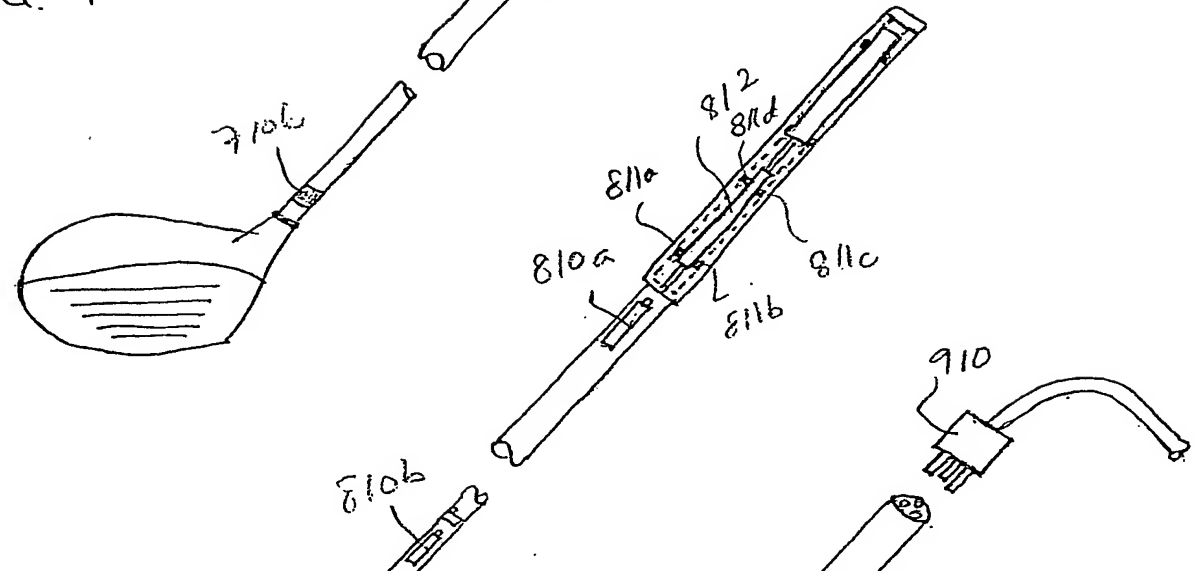
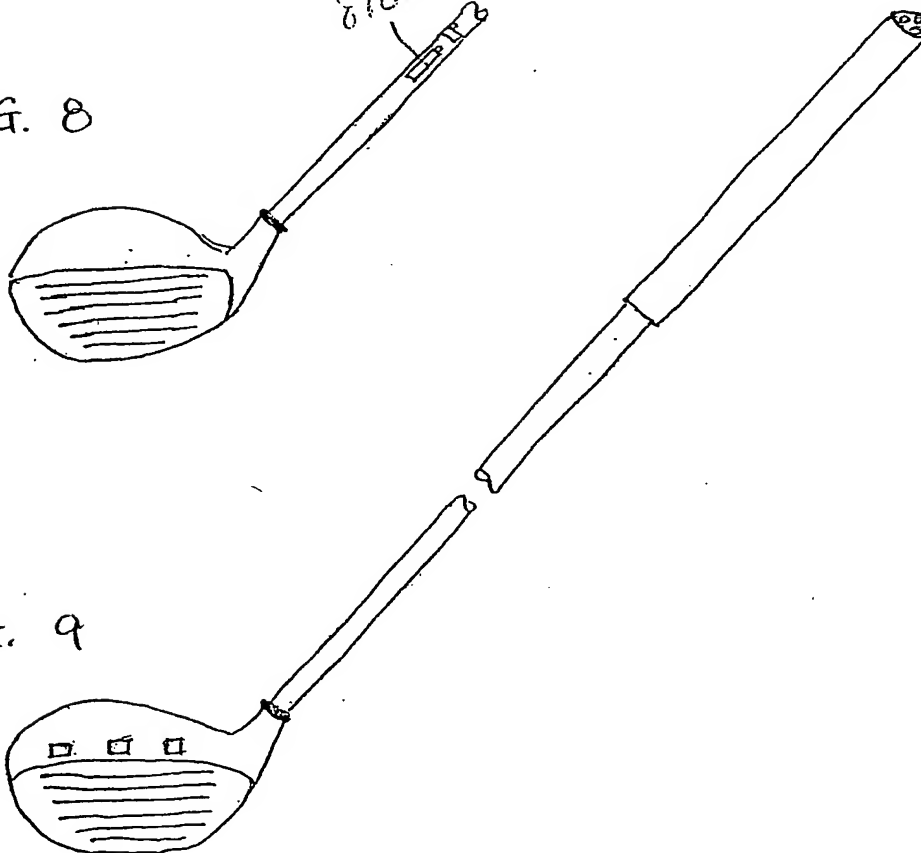


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US02/20938

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G06G 7/48; A63B 53/12

US CL : 473/199, 409

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 473/199, 409, 131, 221

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
None

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
None

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,137,566 A (HAAS et al) 30 January 1979, See the entire document.	1-45

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T"

later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X"

document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y"

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search

26 September 2002 (26.09.2002)

Date of mailing of the international search report

05 NOV 2002

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703)305-3230

Authorized officer

M. Sager

Telephone No. 703-308-0858

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.